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NUCLEAR SCIENCE ABSTRACTS

Vol. 4 No. 6

Table of Contents for March 30, 1950

Category	Abstract	Page
REFERENCE LIST		iii
GENERAL		259
Atomic Power	1613	
BIOLOGY AND MEDICINE		259
Radiation Effects	1617	
Radiation Hazards and Protection	1630	
Radiotherapy	1635	
Toxicology Studies	1654	
Tracer Applications	1659	
CHEMISTRY		270
Analytical Procedures	1683	
Atomic Weights and Periodic Systems	1684	
Deuterium and Deuterium Compounds	1685	
Fluorine and Fluorocarbons	1686	
Laboratories and Equipment	1691	
Radiation Effects	1694	
Rare Earths and Rare Earth Compounds	1697	
Syntheses	1699	
Tracer Applications	1700	
Uranium and Uranium Compounds	1705	
ENGINEERING		274
Heat Transfer and Fluid Flow	1706	
Vacuum Systems	1707	
MINERALOGY, METALLURGY AND CERAMICS		274
Geology and Geophysics	1708	
Metals and Metallurgy	1709	
Minerals and Mineralogy	1714	
PHYSICS		275
Cosmic Radiation and Mesons	1715	
Instruments	1732	
Isotopes Separation	1742	
Mass Spectrography	1745	
Mathematics	1746	
Measuring Instruments and Techniques	1747	
Meteorology	1779	
Microwaves	1783	
Neutrons	1785	
Nuclear Physics	1789	

TABLE OF CONTENTS FOR MARCH 30, 1950

Category	Abstract	Page
PHYSICS		
Nuclear Properties	1792	
Nuclear Reactors	1805	
Nuclear Transformations	1806	
Particle Accelerators	1808	
Radiation Absorption and Scattering	1817	
Radioactivity	1822	
Theoretical Physics	1831	
AUTHOR INDEX		A
SUBJECT INDEX		C
FOREIGN GEOGRAPHIC INDEX		J
NUCLIDE INDEX		K
PUBLISHED DOCUMENTS INDEX		L
NNES ANNOUNCEMENT		M

REFERENCE LIST

Vol. 4 No. 6

ATOMIC ENERGY COMMISSION DOCUMENTS REFERENCE LIST

Document	Title, Author	Abstract
AECD-2797	Preliminary Results on the Spin of U^{235}. G. L. Stukenbroeker and J. R. McNally.	1792
AECU-673	Methods of Preparing Bone and Tooth Samples in the Electron Microscope. R. A. Robinson and F. W. Bishop.	1615
AECU-674	Dissociation and Exchange Equilibria of the Tritium Halides. Jacob Bigeleisen.	1685
AECU-675	Some Properties of the Parallel Spark Counter. II. Leon Madansky and R. W. Pidd.	1747
AECU-676	In Vitro Transfer of Radioiron Across the Nucleated and Non-Nucleated Erythrocyte Membrane. L. M. Sharpe, P. S. Krishnan and J. R. Klein.	1659
AECU-677	Irradiation Effects on Allomyces Arbusculus. Katherine E. Yaw.	1617
AECU-678	Scintillation Type Ion Detector. Paul I. Richards and E. E. Hays.	1748
AECU-679	Nuclear Quadrupole Moments and Nuclear Shell Structure. C. H. Townes, H. M. Foley, and W. Low.	1793
AECU-680	Gas Phase Counting of Low Energy Beta Emitters. W. Bernstein, and R. Ballentine.	1749
AECU-681	Tolerance of Tradescantia to Continuous Exposures to Gamma Radiation from $Cobalt^{60}$. Arnold H. Sparrow.	1618
AECU-682	Desirable Improvements in Nucleonics Instrumentation. J. B. H. Kuper.	1750
AECU-683	Electronic Exchange and Oxidation-Reduction Reactions in Inorganic Systems. J. W. Gryder.	1700
AECU-684	General Aspects of Meteorology in the Air Pollution Program. Norman R. Beers.	1779
AECU-685	The Effect of Electronic Paramagnetism on Nuclear Magnetic Resonance Frequencies in Metals. W. D. Knight.	1794
AECU-686	A Laboratory Alpha Scintillation Counter. W. Bernstein, E. H. Foster, and D. G. Clareus.	1751
AECU-687	On the Mechanism of the Chemical Formation of Lactic Acid from Glucose Studied with C^{14} Labeled Glucose. Martin Gibbs.	1701
AECU-688	Micro-Climatic Factors in Smoke Pollution from Tall Stacks. Phillip H. Lowry.	1780
AECU-689	An Improved Method of Directing Liquid Flow in a Closed System. L. G. Stang, Jr., and G. J. Selvin.	1691

REFERENCE LIST

Document	Title, Author	Abstract
AECU-690	A Semi Automatic Injection Apparatus for Use with Radioactive Solutions. Margaret W. Holt.	1692
AECU-691	Non-Random Distribution of Chromosome Fragmentation in Unirradiated Trillium. A. H. Sparrow and E. Christensen.	1619
AECU-692	Evaporating Jig for Geiger-Mueller Tubes. William Liben.	1752
AECU-693	The Pattern and Significance of Delayed Phenotypic Expression of Mutations Induced in E. Coli by Absorbed P^{32}. B. A. Rubin.	1620
AECU-694	On the Secondary Particles of Local Penetrating Showers. O. Piccioni.	1715
AECU-695	The Reliability of the Bacterial Degradation of C^{14} Labeled Glucose. Martin Gibbs.	1660
AECU-696	Charged Particles of Low Energy Associated with the Ends of μ Meson Tracks. M. Blau, M. Block, H. Friedman, and J. Nafe.	1716
AECU-697	Preparation of a Parallel Plate Spark Counter. R. W. Pidd and L. Madansky.	1753
AECU-698	Nuclear Magnetic Resonance Shift in Metals. W. D. Knight.	1795
AECU-699	The Preparation of C^{14} Uniformly Labeled Fructose by Means of Photosynthesis and Paper Chromatography. Sidney Udenfriend and Martin Gibbs.	1699
AECU-700	Detection of Tracks and Stars in Nuclear Track Plates. E. H. Land, G. Bird, and W. A. Shurcliff.	1754
AECU-701	A Guide to Russian Scientific Periodical Literature. Spencer C. Stanford.	1681
AECU-702	The Forecasting of Micrometeorological Variables. Maynard E. Smith.	1781
AECU-703	Diffusion of Stack Gases in Stable Atmospheres. Morton L. Barad.	1782
AECU-704	The Frequency of Spontaneous Chromosome Breakage in Trillium. A. H. Sparrow and Rhoda C. Sparrow.	1621
AECU-705	Periodic Heat Transfer by Radiation Through Layers in a Vacuum. Fred L. Whipple and J. Orten Gadd.	1706
AECU-706	Natural Convection Cooling of Liquid Homogeneous Reactors. Howard Schwartz.	1805
AD-171	The Association of Cerous Ion with Sulfite, Phosphate, and Pyrophosphate Ions; Interim Report. Stanley W. Mayer and S. David Schwartz.	1697
AERE-G/R-191	Betatron Injection in Synchrotrons. F. K. Goward.	1811
ANL-4333	Argonne National Laboratory Biological and Medical Divisions Quarterly Report May, June, July 1949. Austin M. Brues and Herman Lisco, editors.	1616
CUD-45	Progress Report for July, August, and September 1949. J. R. Dunning.	1791
K-533	Fractionation of Chlorotrifluoroethylene Liquid Polymer. N. C. Orrick.	1686
K-550	A Low Temperature Cryostat. G. D. Oliver, J. W. Grisard, and V. E. Anderson.	1732
M-4459	The Low State of Li^7. R. Avery and C. H. Blanchard.	1796

REFERENCE LIST

Document	Title, Author	Abstract
M-4460	Outline for Course in Health Physics 1948-49. University of Rochester.	1632
M-4463	Austin Beta-Gamma Hand and Foot Checker; Test Reports. J. G. Roback and W. E. Doniger.	1755
MLM-399	A Low-Powered Induction Heater for Laboratory Use, Model HE-1 (Final Report). R. L. Shippe, Jr.	1693
ORNL-413	Logarithms in Instrumemtation. W. G. James.	1733
RIB-2	Bibliography Radiation Detection, 1st Ed. USAEC Radiation Instruments Branch.	1756
UCLA-50	Relation of Low Temperatures to X-ray Injury of Hematopoietic Tissue of Tadpoles (Preliminary Account). Bennet M. Allen, Ole Arne Schjelde, and Lynette B. Hochwald.	1622
UCRL-457	The Oscillator for the Injector Cyclotron of the Quarter Scale Bevatron. W. R. Baker.	1808
UCRL-458	Inelastic Scattering of Protons by Aluminum and Carbon. C. Levinthal, E. A. Martinelli, and A. Silverman.	1820
UCRL-477	The Destructive Action of Astatine^{211} (Element 85) on the Thyroid Gland of the Rat. J. G. Hamilton, C. W. Asling, W. M. Garrison, K. G. Scott, and D. A. Heller.	1635
UCRL-530	Stars in the Photographic Emulsions Initiated by π^--Mesons. Frank L. Adelman and Stanley B. Jones.	1717
UCRL-533	Theoretical Calculations of the Stability of Solid and Gaseous Species in the Alkali and Alkaline Earth Oxide Systems. Leo Brewer and Donald F. Mastick.	1682
UCRL-563	The Role of Formaldehyde and Formic Acid in the Preparation of Demerol-N-Methyl-C^{14}. Winifred Tarpey.	1703
UCRL-573	A Preliminary Report on the Mechanism of the Decomposition of Diacetyl Peroxide in Acetic Acid. A. J. Fry, B. M. Tolbert, and Melvin Calvin.	1702
Y-530	Design of an Equipotential Tray. G. E. Mellen, E. C. Witt, A. L. Boch, and R. S. Livingston.	1809
Y-538	Refrigeration System Used in Mercury Isotope Collections F. R. Duncan and W. G. Cobb.	1742

GENERAL

1613 Constructive Applications of Atomic Energy—What Are the Prospects? J. Berkovitch. Chem. Age (London) 62, 64-8(1950) Jan. 14.

In this discussion of the constructive applications of atomic energy, emphasis is placed on British developments. Phases of the development of successful applications of atomic energy which are considered are: uses of isotopes, artificially induced radioactivity, detection of radiation, tracer techniques, allocation of isotopes, protective clothing, measurement, pilot plants, industrial blasting, and economic aspects.

1614 The Future of Atomic Energy. J. R. Dunning. Am. Scientist 38, 60-85(1950) Jan.

The author describes, in nontechnical language, the fission process in U^{235}. He then discusses the use of moderators and the problems involved in designing a satisfactory moderator system. Diffusion and electromagnetic separation methods are outlined, and the Oak Ridge and Hanford plants, for the production of U^{235} and plutonium, respectively, are briefly described. Possible future applications of atomic energy are discussed in the last section. The author concludes that concentrated fuels are necessary for the practical production of atomic energy, and that these fuels will have to be produced by some sort of breeding process. Such a fuel could be utilized in a nuclear power plant similar in design to one suggested by the author.

BIOLOGY AND MEDICINE

1615 Methods of Preparing Bone and Tooth Samples for Viewing in the Electron Microscope. R. A. Robinson and F. W. Bishop. AECU-673, Sept. 27, 1949. 7p.

Three methods of preparation of specimens for observation in the electron microscope have been developed. These are described and compared in this paper.

1616 Argonne National Laboratory Biological and Medical Divisions Quarterly Report May, June, July, 1949. Austin M. Brues and Herman Lisco, Eds. ANL-4333, nd. 143p.

The status of research is reported for the following subjects: effect of x-radiation on antibody formation; blood picture of chromically irradiated LAF-1 mice; effect of radiation on a transplantable mouse lymphoma; the 30-day LD-50 and accompanying blood picture of hybrid guinea pigs; comparison of the biologic effect of 186-kv and 11.4-Mev x-rays; comparison of the 30-day LD_{50} for mice following total-body irradiation with x-ray and intervenously administered radon; the 30-day LD_{50} retention, distribution, and concentration of polonium in CF-1 female mice; the effect of total time of treatment upon survival of young chicks following x-irradiation; a quantitative method for the determination of polonium in animal tissues; counting and calibration of Geiger counting and calibration apparatus; effect of x-irradiation on the ultraviolet absorption spectrum of crystalline bovine serum albumin; preliminary report on effects of high dosages of x-rays on Paramecium aurelia; plutonium and yttrium content of the blood, liver, and skeleton of the rat at different times after intravenous administration; toxicity of tritium oxide to mice.

1617 Irradiation Effects on Allomyces Arbusculus. Katherine E. Yaw. AECU-677, nd. 1p.

BIOLOGY AND MEDICINE

The document is in abstract form; it is reproduced below in its entirety.

After the growth factor requirements of Allomyces arbusculus (Phil. Isls. 1) were determined to be methionine and thiamin, the haploid zoospores from the resistant zoosporangia were treated with ultra-violet light for the purpose of producing biochemical mutants. Mutant strains were isolated which required additional amino acids, but none were found which needed other B vitamins or the purines and pyrimidines of nucleic acid. Most of the amino acid requiring strains failed to release gametes normally, but two strains (7 and 23) were found which did behave like wild type in this respect. Strains 7 and 23 were crossed and the resulting sporophytes grew in minimal medium. From single resistant zoosporangia of this cross, both strains were reisolated. Attached male and female gametangia of 7 have been isolated using capillary pipettes. From these isolations sporophyte colonies have resulted only rarely, but when male gametangia of wild type have been added, many sporophyte colonies have been produced suggesting the development of a self sterile, cross fertile strain of this fungus.

1618 Tolerance of Tradescantia to Continuous Exposures to Gamma Radiation from $Cobalt^{60}$. Arnold H. Sparrow. AECU-681, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Plants of a clonal line of Tradescantia paludosa were exposed under field conditions to continuous gamma radiation (1.1 and 1.3 Mev) of approximately 122, 30.4, 7.5, 1.8, 0.41 and 0.084 r per day, for 8, 16, 32, and 64 days. Dosage rates of 122 and 30.4 r per day permitted little or no growth, while fairly normal growth occurred at 7.5 r per day or less. Complete pollen abortion was produced after 16 days at 122 r per day.

Chromosome breaks as such were not scored, but micronuclei at the microspore resting stage were counted. These are assumed to represent acentric fragments which lagged and remained in the cytoplasm at second telophase. A significant increase in the frequency of micronuclei was obtained with as low as 84 mr per day after 32 days exposure (total dose 2.69 r).

Dosage curves for various exposure times will be presented. An attempt will be made to relate growth-inhibiting and lethal doses to the percentage of microspores containing micronuclei.

1619 Non-Random Distribution of Chromosome Fragmentation in Unirradiated Trilluim. A. H. Sparrow and E. Christensen. AECU-691, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

An unusual type of spontaneous chromosomal fragmentation has been found in a plant of Trillium erectum. There is considerable variation from anther to anther though some appear normal. In the most extreme case about 4% of the microsporocytes show aberrations. However, within this small group of cells chromosome fragmentation reached an extreme of about 30 breaks per cell. This is equivalent to that produced by a dose of at least 100 r at a highly sensitive stage or of not less than 5,000 r at a stage of low sensitivity. Statistical analysis shows the distribution of break frequency in the abnormal cells to differ significantly from that ex-

pected in irradiated material. The reason for this difference is not understood. Other abnormalities such as "fused" microsporocytes indicate that a physiological disturbance may be responsible. The seriousness of this type of spontaneous fragmentation in radiation experiments involving the use of chromosome breaks as a measure of radiation effect is obvious.

1620 The Pattern and Significance of Delayed Phenotypic Expression of Mutations Induced in E. Coli by Absorbed P^{32}. B. A. Rubin. AECU-693, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Biologically absorbed radioactive phosphorus (P^{32}) has been shown to induce significant increases in the proportion of streptomycin resistant cells among growing populations of Escherichia coli (strains B and B/r). Great differences in the absorption of P^{32} by the bacteria have been produced by varying carrier phosphorus. Calculations show that large increases in concentration of P^{32}, in a cell of bacterial dimensions, produce insignificant changes in specific ionization. The increase in mutation rate, however, is disproportionately high. When bacteria were grown in solutions of P^{32} (up to 8 mc per ml) the mutation rate increased with dose. But in all cases the relative size of the mutant population changed upon further cultivation. The pattern of change (diverse rates of increase, sometimes followed by decrease) varied with the concentration of P^{32} and with the amount of absorption, as controlled by carrier phosphorus levels. The complete phenotypic expression of the mutations produced seemed also to depend upon the number of bacterial divisions, since similar changes did not occur in resting cultures exposed in the same way, for similar periods. These patterns indicated a quantitative, as well as qualitative difference in distribution of mutant types produced by an effect which can not be accounted for by ionization alone. Calculations indicate that this effect may be attributed to the transmutation of P^{32} to S^{32}.

1621 The Frequency of Spontaneous Chromosome Breakage in Trillium. A. H. Sparrow and Rhoda C. Sparrow. AECU-704, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The frequency of spontaneous chromosome breakage in Trillium erectum has been determined by counts made at first meiotic anaphase and at microspore metaphase. These will be compared with the frequency of micronuclei observed at the tetrad and postmeiotic interphase stages. Statistical analysis will be presented to show the significance (if any) of differences in the frequencies observed at various stages within a plant and also the differences between plants, between buds within a plant and between anthers within a bud. The results of such an analysis will be exceedingly useful in determining significant changes in chromosomal aberrations induced experimentally by irradiation or by chemical mutagens.

1622 Relation of Low Temperatures to X-ray Injury of Hematopoietic Tissue of Tadpoles. (Preliminary Account). Bennet M. Allen, Ole Arne Schjelde, and Lynette B. Hochwald. UCLA-50, Nov. 30, 1949. 9p.

Tadpoles of Rana catesbiana, from 70-90 mm total length, were subjected to x-irradiation with and without refrigeration, and were killed at specific time intervals during which some were refrigerated and some kept at normal (out-of-doors) temperatures. Counts of normal and dead hematopoietic cells were taken with the following results: (1) The temperature of tadpoles at the time of x-ray treatment makes little if any difference in the destructive processes that develop later; and (2) These destructive effects depend primarily upon the temperatures to which the tadpoles are subjected after irradiation.

1623 The Action of Ionizing Radiations on Striated Frog Muscle. Z. M. Bacq, J. Lecomte, and A. Herve. Arch. intern. physiol. 57, 142-53(1949) Dec. (in French).

Experiments are reported on the rectus abdominus muscle of Rana temporaria suspended in oxygenated Ringer solution and excited at regular intervals by 5% KCl. The β rays from P^{32} were employed as one test of ionizing radiation effects; the P^{32} was added in increasing amounts to a bath containing the frog muscle. The x-ray experiments were of several types: x-radiation at 190 kv with a 5 mm Al filter and at a target distance of 40 cm was employed to deliver doses at the rate of 200 r/min to previously dried muscle; contact x-ray therapy at 50 kv and with no filtration was also used on the dried muscle; x-irradiation of the frog muscle in Ringer's solution was used; and, irradiation of the Ringer's solution itself with 4,000-8,000 r was also attempted and the H_2O_2 content determined. It was found that both the x-rays and β radiations determined the appearance of the Lundsgaa Lundsgaard effect (contraction of striated muscle after work). This is considered proof by the authors of muscular glucidic metabolism; the irradiations are enzyme poisons. The calculations of the amounts of peroxides formed in the solution during different stages of the irradiations made possible accurate observations. 27 references.

1624 Cyanide and X-rays. Z. M. Bacq and A. Herve. J. physiologie 41, 124-A-125-A(1949)(in French).

In a previous note it was shown that an injection of 0.1 mg NaCN made immediately before x-irradiation of 580 r reduced to 30% what would have been 100% mortality in mice. New experiments are reported here on mice which received larger doses of NaCN and x-irradiation of 650 r. An injection of 0.1 mg NaCN immediately before irradiation reduced the 100% mortality to 50% while the same amount of NaCN immediately after irradiation delayed the 100% mortality for three to four days; if the injection was made 15 min after the irradiation, no reduction in the mortality rate occurred. Sulfocyanide produced no reduction in mortality when injected before irradiation; when irradiation producing a mortality rate of 10-40% was administered, a prior injection of 0.1-1 mg of the sulfocyanide augmented the mortality rate. The injection of 1 mg of α tocopherol 40 hr and 24 hr before the irradiation reduced to 30% a mortality rate of 60% in the controls. The author's theory of the protective action of these compounds is that important chemical reactions take place in the organism which are influenced by the cyanides; the reactions are connected with the formation of peroxides by x-irradiation and the action of peroxides on the cells of the organism.

BIOLOGY AND MEDICINE

1625 Fractures of the Femoral Neck and Osseous Alterations after Pelvic Irradiation. Henri Kritter. Semaine Hopitaux Paris 25, 2999-3001(1949) Oct. (in French).

The author reports 17 cases of pathological fractures of the neck of the femur discovered after elevated doses in x-ray therapy (up to 20,000 r) uterine maladies. It was found that in cases of spontaneous healing of uterine diseases, no fractures occurred. This would seem to refute the older assumption that femoral fractures are due to metastases from the uterine lesions and to indicate that radiotherapy may be the cause of the weakened bones. The author concludes that a radiotherapeutic bone effect occurs which is similar to the radiotherapeutic lung effect.

1626 Further Studies on the Influence of Dose Fractionation on the Lethal X-ray Effect Produced by Total Body Irradiation in Mice. Friedrich Ellinger and James C. Barnett. Radiology 54, 90-2(1950) Jan.

The influence of the size of the single exposure and overall exposure time on the lethal effect of total body irradiation of mice with x-rays was studied. A total of 220 white male Swiss mice were used in this experiment, twenty of which served as unirradiated controls. The irradiation was delivered by a 200 kv source through 0.25 mm Cu and 1.0 mm Al total filtration at a target distance of 50 cm and a dosage rate of 23.4 r/min. The effect of 1,000 r in air in one exposure (LD_{100}) was compared with that of the administration of the same dose when given in single fractions of 100-50 r in air within 10-20 days. It was found that the effect of dose fractionation in total body irradiation depends on the size of the single fraction as well as on the overall exposure time; of these two factors, the size of the fraction appears as the more important. It also appears that, as with observations on tumor destruction, there exists a certain optimum for dose fractionation in total body irradiation. (auth.)

1627 The Histological Structure of the Ovaries of Fetal Mice after the Destruction of the Hypophysis by X-rays. Albert Raynaud and Marcel Frilley. Compt. rend. soc. biol. 143, 959-63(1949) July (in French).

The hypophyseal line was destroyed in five female mice by irradiating the base of the cranium at the age of 12 or 13 days with a narrow localized beam of x-rays for a total dose of 150,000-200,000 r; the irradiated and control animals were sacrificed when 18 days old. It was found that after the hypophyseal destruction the general growth of the ovaries was not affected noticeably; the germinal cells were entering the miotic prophase. It is concluded that if the destruction of the hypophysis in each animal can be assumed to be done completely and quickly upon irradiation, the ovarian growth must be independent of fetal hypophyseal secretions.

1628 The Histological Structure of the Testicles of Fetal Mice after Destruction of the Hypophysis by X-radiations. Albert Raynaud and Marcel Frilley. Compt. rend. soc. biol. 143, 954-8(1949) July (in French).

A total of five fetuses, with their hypophyses destroyed by means of elevated doses of x-rays (up to 200,000 r), were examined to determine the effects on the histological structure of the testicles. The x-radiations were delivered in one dose of 100,000 r at the age of 12 days and an additional 100,000 r dose at 13 days, localized in an area with 2.5 mm diameter; the fetuses were sacrificed at the age of 18 days and examined histologically. It was found that the testicles were differentiated sexually; the relative growth and dimensions of the testicular tubules were not preceptibly modified, however. The interstitial gland of the testicle was relatively well developed. The studies indicate that if the destruction of the hypophyseal line occurs rapidly and completely the testicular growth and the development of the interstitial gland may then be accomplished in a nearly normal fashion.

BIOLOGY AND MEDICINE

1629 Mutations Induced in Drosophila by Ingested Phosphorus-32. A. J. Bateman and W. K. Sinclair. Nature 165, 117-18(1950) Jan. 21. (Letter to the editor)

Radioactive phosphorus, P^{32}, was administered to the larvae of Drosophila melanogaster in order to determine the number of mutations which could be induced by the radioisotope. The highest specific amount introduced into the larvae bottles was 1 mc/bottle; this resulted in the death of all the insects before pupation. A 0.1 mc amount resulted in the death of an appreciable number of the specimens, while the introduction of 0.01 mc of P^{32} resulted in no appreciable number of deaths. Flies emerging from the 0.1 mc bottles were further studied; their activity was measured and, though it was variable, the mean figure was 0.0122 μc/fly two to three days after emergence. The overall lethal mutation rate observed (7.3%) is the rate which would be expected for an x-ray dose of 2,500 r. The lethal mutation-rate/g-r was derived for the P^{32} and for a dose of 2,500 r of x-rays and was found to be similar, but the author cautions that much significance should not be attached to this similarity. The high mutation-rate of visibles produced by the P^{32} corresponds to the expectation from 12,000 r of x-rays. It is concluded that additional work is necessary to confirm whether P^{32} is really four times as efficient as x-rays in the production of visible mutations. Further work on the general effects of the radioisotopes on mutations is in progress.

1630 Health Hazards in Radiation Work. M. Ingram. Science 111, 103-9(1950) Feb. 3.

The author describes the nature and physiological effects of the various types of nuclear radiation which are encountered in clinical and laboratory work. It is noted that the effectiveness of safeguards against radiation damage depends mainly on the vigilance of the individual worker. So far, accidental over-exposures have been very rare, but despite their limited expedience in the field, medical men have developed methods of treatment for overexposures of short duration.

1631 Modern Radiation-Detection Instruments for Health Protection. Everett W. Molloy and Arnold O. Beckman. Mech. Eng. 71, 649-52(1949) Aug.

The author gives a brief summary of the nature and ionizing effects of the different types of nuclear radiation, then describes in popular terms the operation of several detectors. This description includes separate sections on ionization chambers, Geiger counters, and proportional counters. The author then discusses the use of these detectors in the more common types of detecting instruments. The conclud-

ing section treats the type of instrument which indicates the total amount of radiation received by the worker over a given period.

1632 Outline for Course in Health Physics, 1948-1949. University of Rochester. M-4460, nd. 20p.

A course in health physics to be given as a one-year course is described. It consists of the following subjects: instrumentation and monitoring; industrial hygiene and toxicology; radiation biology; introduction to research; introduction to modern physics; introduction to nuclear physics; mathematics. A list of required texts and reference books is included.

1633 Physical Methods of Achieving Protection for High Energy Radiation and Radioactive Isotopes. W. G. Marley. Proc. Roy. Soc. Med. 62, 927-34(1949) Nov.

In this summary of the physical methods necessary for the protection of personnel from ionizing radiations, the maximum permissible dose is defined, the methods of measuring the radiation intensity and dosage to the personnel, specific hazards, and the problems of waste disposal are all briefly covered. It is concluded that the more hazardous radiations encountered specifically in areas where the work is primarily on physics projects include hard γ rays, hard x-rays and fast neutrons, arising from cyclotrons, piles or Van de Graaf generators. The main problem in chemistry areas is the prevention of contamination of laboratory benches, fume hoods, floors, and the air; the provision of suitable monitors is essential to prevent the build-up of contamination. As far as is possible active material should be precipitated from solution and disposed of as an insoluble residue. Other measures are briefly outlined for the protection from radioactive compounds.

1634 Practical Aspects of Medical Supervision. Katharine Williams. Proc. Roy. Soc. Med. 62, 923-7(1949) Nov.

Some measures for the protection of personnel from irradiation from x-rays and radioactive isotopes are considered and discussed. Distance and proper shielding are noted as the two most general and effective protective factors; the importance of ventilation, area monitoring, individual monitoring and personnel education is also stressed. Laboratory tests by biochemical and counting methods are considered an essential part of any protection program. It is concluded that with careful control and monitoring the dosage of ionizing radiation can be kept to 0.1 r/week; such protection has been afforded at the Atomic Energy Research Establishment at Harwell, England.

1635 The Destructive Action of Astatine^{211} (Element 85) on the Thyroid Gland of the Rat. J. G. Hamilton, C. W. Asling, W. M. Garrison, K. G. Scott, and D. Axelrod Heller. UCRL-477, Oct. 1, 1949. 8p.

The observation that astatine accumulates in the thyroid suggests that this new element might be of possible therapeutic application in hyperthyroidism. Preliminary thyroid uptake studies in the rat revealed that in a group of eight 200-g animals of both sexes that from 2-8% of the administered As^{211} was present in the thyroid at the end of 18 hr,

the necessary corrections for the decay of the As^{211} having been applied. Three 200-g white rats were selected to observe the radio-biological action of the α-particle irradiation of the thyroid from the accumulated As^{211}. The As^{211} in an isotonic solution of NaCl was administered to two of the rats by intraperitoneal injection. They received 10 μc and 50 μc, respectively. The third animal was used as a control. After 30 days the three animals were sacrificed and the thyroids removed. The tissue was fixed, embedded in paraffin, and the sections stained with haemotoxylin and eosin for histological study. The sections were cut in such a manner that from each of the three thyroids a portion of the parathyroid was included. The results from this preliminary study demonstrate the capacity of astatine to induce an extreme degree of radiation injury of the thyroid gland in the rat without apparent involvement of the adjoining parathyroid gland.

1636 Apparatus for Producing a Convergent X-ray Beam. Ludo K. Frevel (to Dow Chemical Co., Midland, Michigan, Corp. of Delaware). U. S. Patent 2,472,745, June 7, 1949.

This device produces a beam of x-rays in the form of a hollow convergent cone; it avoids the disadvantages of greater surface skin exposure during irradiation of a deep-lying condition and also produces sharply defined x-ray film outlines when used for diagnosis. The device consists essentially of an x-ray tube (of the 40-200 kv range and hot-cathode high vacuum type) having an annular or ring-shaped target and a shield associated with the tube and containing one or more annular slits so placed with respect to the target as to limit the issuing tissue, the x-ray tube and its special support are adjusted so that the focal point of the x-ray beam is within the region; then the motor drive turns the x-ray tube through and along a circular path and the convergent beam is focused on the tumor through an ever-changing area of over-lying tissue. This, in combination with the hollow beam advantage tends to reduce the x-ray dose per area of over-lying tissue.

1637 Cancer of the Lip. Bernard Pierre Widmann. Am. J. Roentgenol. Radium Therapy 63, 13-24(1950) Jan.

A standard low x-radiation technique was used in the treatment of the shallow type of lesion encountered in some of the 369 cases of cancer of the lip reviewed here. The radiation technique consisted of the delivery of 3,000-4,500 r in air at 80-145 kv with an inherent filtration of about 0.5 mm Al; the rate was 1,000-1,500 r three times a week; with areas larger than 2 cm in diameter, the dose was reduced to 500 r three times a week and the total dose increased to 3,500-5,000 r. For the larger lesions 200 kv therapy was instituted with a total dosage of 5,000 r administered in fractionated doses of 300-500 r. Other dosages and dose rates are described for specialized conditions, but the overall average dosage approximated 6-8 threshold erythema doses for either radium or x-rays of different qualities, with equally good results for either of these agents. The results of the cases indicated that a cure rate as high as 83% may be possible by irradiation procedures for all types of early and advanced cancers of the lip.

1638 Carcinoma of the Cervix. Statistical Evaluation of 1,938 Cases and Results of Treatment. John McL.

Morris and Joe V. Meigs. Surg. Gynecol. Obstet. 90, 135-50(1950) Feb.

The results of the treatment of a total of 1,851 patients with carcinoma of the cervix with x-radiations, radium, surgery, or combinations of these methods are presented. The factors related to the incidence of the disease are reviewed and discussed. X-ray treatments were individualized but in general consisted of 7,000-8,000 r in air or 3,000-4,000 r tumor dose from a 200-1,200 kv source through several pelvic portals; vaginal cone therapy was not used. Radon was used extensively in the form of interstitially placed glass or gold seeds; its use was gradually discontinued. Radium was given both as interstitial radiation in the form of 2-10 mg needles and as intracavitary radiation with Ag or Pt applicators; the dosages were 2,000-8,500 mg hr. At the present time dosages of 4,000-4,500 mg hr are used. Cervicectomy and abdominal or vaginal hysterectomy were not used; the Wertheim type of hysterectomy was used as a radical operation. Of 140 cases treated by x-rays alone, a five-year cure rate of 4.3% occurred when 140 cases were treated by x-rays alone; of 711 cases treated solely by radium, 23.1% survived five years, compared with an 81.8% survival for 33 cases of surgery. A combination of x-rays and radium caused a 17.3% survival rate for 913 patients, and a combination of surgery and radiation produced a 42.6% survival in 54 cases.

1639 Current Therapeutics. XXV. Radioactive Isotopes. J. F. Loutit. Practitioner 164, 77-82(1950) Jan.

A review has been presented covering the quality and therapeutic uses of x-, α, β, and γ rays and the radioactive isotopes I^{131} and P^{32}. Special mention is made of the application of I^{131} in cases of carcinoma of the thyroid and in hyperthyroidism and of P^{32} in cases of polycythaemia rubra vera.

1640 Dosage Determination in the Use of Radioactive Isotopes. Leonidas D. Marinelli. J. Clin. Invest. 28, Pt. 1, 1271-80(1949) Nov. (See also NSA 1-701.)

In this extensive paper, formulas expressing the relationship between radiation dose and isotope concentrations are presented and their clinical applications are discussed by the use of tables containing a considerable amount of information. Examples of the application of the formulas to such specific isotopes as P^{32}, Sr^{89}, Ca^{45}, Na^{24}, Na^{22}, K^{42}, I^{131}, I^{130} are included along with definite problems. In the two specific tables presented, for β and γ rays, respectively, the half-life, radiation average energy, fraction disintegrating per day, and specific dosage data are contained. References for those isotopes which are not included in the body of the article or for supplementary information are presented in a special section in the bibliography.

1641 Early Detection of Cretinism and Other Diagnostic Uses of Radioactive Tracers in Infancy and Childhood. L. Reynolds, K. E. Corrigan, and H. S. Hayden. Harper Hosp. Bull. 8, 4-6(1950) Jan.-Feb.

A group of children at the Harper Hospital was investigated by means of the radioactive tracers I^{131} and P^{32} for illnesses not readily detectable by ordinary clinical diagnostic procedures. Of the 46 believed to have disturbed thyroid function and studied with I^{131}, 3 were found to be total cretins with no demonstrable amount of functioning thyroid tissue

present; 14 of the patients had hypothyroidism; and the balance were in the minimal normal function group (2 of which had carcinomas, 1 a thyroglossal duct cyst, and 4 had toxic diffuse goiters). It is stated that the isotopic technique demonstrates the presence of incipient cretinism before it can be demonstrated with certainty by any other means and makes possible early diagnosis and appropriate therapy by distinguishing cretinism from Mongolism and those conditions which simulate it. Uptake and excretion curves are presented. The studies with P^{32} involved the early detection of such malignancies as osteogenic sarcoma, brain lesions, an abcess, and one cystic degenerative process.

1642 The Early Diagnosis and Treatment of Pelvic Malignancy. Robert A. Kimbrough. Mississippi Doctor 27, 402-6(1950) Feb.

The results of the treatment of carcinoma of the cervix, endometrium, and ovary are presented. The usual technique at the Pennsylvania Hospital, Philadelphia, for the treatment of cervical carcinoma was delivery of 2,000-2,800 r from a 200-kv source to one port, anteriorly and posteriorly; the filtration employed was 1.0 mm Al and 0.5 mm Cu and usually doses of 200 r were delivered three times weekly. More recently irradiation by a cervical port and through an intravaginal cone supplemented the treatment; six weeks after the completion of the x-ray cycle, approximately 6,000 mg hr of radium were applied to the cervical area. Carcinoma of the endometrium was treated by the intrauterine application of 100 mg of widely distributed radium, filtered by 1 mm of platinum for a period of 40 hr; total hysterectomy and bilateral salpingo-oophorectomy were performed after an interval of four weeks. Similar surgery was performed before full roentgen therapy of the entire abdomen in the treatment of ovarian carcinoma. An overall five-year salvage rate of 36% is reported for the cervical carcinoma cases, while an 80% rate is presented for the endometrial carcinoma cases. Post-operative x-ray therapy for the ovarian carcinoma cases is claimed to have yielded remarkable responses in some extensive cases.

1643 A Firm X-ray Equipment. Oswald C. Hollstein, Secaucus, N. J. (to F-R Machine Works). U. S. Patent 2,474,422, June 28, 1949.

A device is described which provides a method for directly determining the size of an area to be treated by x-rays and also provides a method whereby every part of the area so treated may be seen and examined when set up for intraoral or intracavitary therapy. With the x-ray source off and with the point source of light provided by this device on, it is possible to determine the precise area the x-ray cone covers. The device is located within an x-ray housing usually below the source of x-rays and consists of a point source of light, a pivoted light reflector interposed in the path of the x-rays and the light rays, (set at a 90° angle from each other) and adjustable, calibrated shutters for regulating the size of the x-ray and light beams.

1644 French Society of Medical Electro-Radiology. Meeting Held on May 21, 1949. Semaine Hopitaux Paris 25, 3202-3(1949) Oct. 18 (in French).

The following paper was among those presented: Indications for the Radiotherapeutic Treatment in Biliary Dystony,

by Giraud, Buffard and Bret. The authors report the successful treatment of biliary dystony in 5 cases; the treatment caused complete relief. The action of the radiotherapy consists of the destruction of the infectious factors present and does not extend to the dystony itself, which is treated primarily by medical methods and medication.

1645 Hidradenitis Suppurativa Axillaris. Samuel George Schenck. Radiology 54, 74-7(1950) Jan.

Of a total of 54 cases of chronic or hyperacute hidradenitis suppurativa axillaris treated by doses of 100-200 r of x-rays for a total of 1,000-1,200 r in air (delivered at 180 kv with a filtration of 0.5 mm Cu and 1.0 mm Al) all responded favorably; the average time for cure was 1.4 months with one resistant case requiring 11 months of therapy before cure. X-ray therapy is concluded to be the most effective treatment since it relieves the pain and aborts the disease; no recurrences have been reported.

1646 Hyperthyroidism and Isotopes. A. Jentzer. Rev. méd. suisse romande (special edition), 51-64(1949) Nov. (in French).

A report is made on the diagnosis of two cases of hyperthyroidism through the use of I^{131}; the isotope was given intravenously in a small amount (0.2-1.0 mc) as a preliminary test and the activity of the thyroid was observed over a period of two to three days by means of a Geiger-Mueller counter. The normal curve recorded for a control subject was in the form of a plateau, slightly increasing with temperature. Both the toxic goiter and the simple goiter tested demonstrated curves with wide fluctuations and a sharp drop-off after 10-12 hrs, indicating a rapid turn-over of the I^{131} in the thyroid gland. The results of microscopic studies are included.

1647 On X-ray Short Distance-Small Field Therapy of Carcinoma of the Penis. Franz Hammer. Krebsarzt 4, 277-81(1949) Oct. 1. (In German)

The genesis of carcinoma of the penis is discussed and its almost nonexistence after early circumcision is referred to. The preferred method of treatment at present is still radical operation; x-ray and radium therapy are less favored. Five cases of penis carcinoma are described and for each case clinical data are given. The total administered dosage for each patient was 11,600-12,640 r delivered by a 160-kv machine, with a 0.5 mm Cu filter, at a focal distance of 30 cm and over a field area of 10×15 cm. Short distance small field radiation with 50 kv and at a 7 or 5 cm target distance over a 2 cm diameter area was also employed. In all of the cases, the primary tumor has healed and remained under control up to two years. Apart from the different radiation quality as compared with radium, the advantage of the therapy employed here lies in the method of physico-technical application. The small field method gives greater protection to the normal tissue.

1648 Planning the Radioisotope Program in the Hospital. Edith H. Quimby and Carl B. Braestrup. Am. J. Roentgenol. Radium Therapy 63, 6-12(1950) Jan.

A summarization is presented concerning the most essential information necessary for establishing a radioisotope program in a hospital; reference is made to a number

of pamphlets concerning special phases of the problem and including cost lists for the essential equipment. A table is presented which lists the most important isotopes and compares their half-lives, maximum energy and other essential data. Laboratory facilities and equipment, shower and dressing room facilities, costs of an isotope laboratory, waste disposal, and the method of applying for radioisotope procurement are among the topics discussed.

1649 Roentgen Therapy and the Relief of Pain. Frederick W. O'Brien. Radiology 54, 1-8(1950) Jan.

A review is presented on the relief of pain and the therapeutic treatment of boils and carbuncles, so-called bursitis, herpes zoster, Marie-Strümpell spondylitis and metastatic bone lesions by x-radiations; the author presents his results for some of these ailments. A total of 78 consecutive cases of shoulder pain was treated by radiation therapy, 70% of which demonstrated calcific-appearing deposits in the region of the supraspinatus tendon, was treated by radiation therapy consisting of 200 r doses from a 200-kv source with a filtration of 0.5 mm Cu and 1.0 mm Al and at a target distance of 50 cm. Each patient received at least four treatments; only two failed to report complete relief of pain. Of 15 cases of herpes zoster treated in a similar manner, with the radiation directed to the spinal nerve roots believed to be involved, all responded to the roentgen therapy. All cases of Marie-Strümpell spondylitis treated by this method and with doses of 200 r twice weekly until each part of the spine received 1,000-1,200 r showed some relief from pain. The mechanism of action of the radiations in the relief of pain is also discussed.

1650 The Therapeutic Application of Radioactive Phosphorus with Special Reference to the Treatment of Primary Polycythemia and Chronic Myeloid Leukemia. Hymer L. Friedell and John P. Storaasli. J. Clin. Invest. 28, Pt. 1, 1308-23(1949) Nov.

The rationale for using P^{32} as an internally distributed source of radiation, and its selective uptake by various normal and tumor tissues has been reviewed; the basis for this, which rests on experimental, biological, and clinical work, is discussed. Experimental and clinical data in this regard are presented; the physical characteristics of P^{32} and its behavior biologically are included. The results of 10 cases of primary polycythemia and 15 cases of chronic myeloid leukemia are reported, confirming the observations of others that these diseases are effectively treated by P^{32}. The isotope P^{32} has also been used for a variety of malignant conditions other than leukemia, but none of the responses have been striking. Mention is made of a possible beneficial application to widespread metastases of bone from carcinoma of the breast. 26 references. (auth.)

1651 Subacute Thyroiditis. George Crile, Jr., and Eugene W. Rumsey. J. Am. Med. Assoc. 142, 458-62(1950) Feb. 18.

Thirty-five patients with subacute thyroiditis were treated at the Cleveland Clinic with total dosages of 250-2,500 r of x-rays, given in daily doses of 100-150 r; only two patients received more than 1,000 r as an initial course. Response to this type of treatment was uniformly good and was, the

authors claim, usually dramatic. Many of the patients were completely relieved of pain after the first or second treatment, and 14 of them achieved complete relief within a week; the pain and tenderness of the thyroid and the systemic symptoms associated with the thyroiditis disappeared on the average by the 13th day, at which time the thyroid was smaller and softer; at the end of a month the thyroid was no longer palpable. There were 6 cases of mild recurrences which disappeared in 5 of the patients upon irradiation with 150 r three of four times. Undesirable after-effects were noted only in two patients, one of which developed a mild transitory hypothyroidism after 2,000 r, and the other hypothyroidism after 1,750 r. Thyroidectomy is concluded to be unnecessary in the treatment of this type of thyroiditis.

1652 The Treatment of a Lingual Thyroid with Radioactive Iodine. J. A. Schilling, J. W. Karr, and J. B. Hursh. Surgery 27, 130-8(1950) Jan.

The results of the treatment of a rare clinicopathologic finding, a lingual thyroid, with radioactive iodine, I^{131}, are presented. An oral test dose of 1.4 mc of the isotope in 200 cc of water was followed by a marked concentration in the region of the base of the tongue; an oral therapeutic dose of 10 mc of I^{131} elicited the same response. Symptoms of dysphagia, dysphonia, hemorrhage, and the annoyed feeling of a mass in the throat gradually disappeared after the therapeutic dose, and on histological examination the lingual thyroid demonstrated atrophy and fibrosis. 38 references.

1653 X-ray Therapy of Non-Malignant Conditions. Paul W. Roman and Stanley H. Macht. Virginia Med. Monthly 77, 71-4(1950) Feb.

A review of the literature on the results of radiation therapy of nonmalignant conditions and on the theories of the action of x-ray therapy is presented together with the results of the treatment of a series of 70 patients. The patients were treated for a variety of ailments including acute dento-alveolar abscess, sub-deltoid bursitis, plantar warts, furunculosis, and keloids. The data from four cases are presented, and indicate that the range of radiation dosage was 250-2,000 r in fractionated delivered doses to one or more portals. A total of 54 of the patients responded well to the treatments, 10 showed slight improvement, and 6 demonstrated poor or no results. It is concluded that x-ray therapy is of real value in the conditions discussed and should be more widely employed. 20 references.

1654 Chronic Pulmonary Beryllosis in Workers Using Fluorescent Powders Containing Beryllium. H. E. MacMahon and H. G. Olken. Arch. Ind. Hygiene Occupational Med. 1, 195-214(1950) Feb.

The results of autopsies of two patients dying as the result of chronic pulmonary beryllosis are reviewed, and the gross and histologic changes observed in the lungs are described and illustrated in detail. The history of exposure is the most important single diagnostic aid; in the early stages the clinical manifestations are nonspecific; they may resemble those of tuberculosis or almost any other type of chronic pneumonitis. A routine physical examination may be of little diagnostic aid. There may be an increase in the number of red cells in the circulating blood, or a very

low oxygen tension, and an electrocardiogram taken late in the disease may show signs of right ventricular strain, while repeated measurements of vital capacity may detect progress of pulmonary damage, but none of these diagnostic procedures are especially effective. Though beryllium has not been directly incriminated as the sole etiologic agent in this disease, it appears to be a most important factor. The authors conclude that this is a comparatively rare clinical and anatomic entity; yet an understanding of it is important, because preventive measures appear to be the only means of satisfactorily controlling it. (auth.)

1655 Industrial Toxicology. Lawrence T. Fairhall. Baltimore, Williams and Wilkins Co., 1949. 483p.

This book outlines the toxicity of many new, as well as old, substances of industrial importance, and is divided into two major sections, inorganic substances and carbon compounds; each substance is discussed briefly and separately, and such topics as characteristics, industrial uses, toxicity, and analysis are presented. Among the inorganic substances described are Be, Cd, Ce, Cb, Ge, In, La, Hg, Os, Pd, Pu, radioactive substances, Th, Ti, U, V, and Zr. Among the carbon compounds, the fluorocarbons are discussed. A list of references is included after each substance presented, and an index is provided.

1656 Studies of the Metabolism of Gallium. II. H. C. Dudley, J. I. Munn, and Katherine E. Henry. J. Pharmacol. Exptl. Therap. 98, 105-10(1950) Jan. (See also NSA 3-1179.)

Radiogallium (Ga^{72}) with a specific activity of 0.11-0.12 mc/mg was injected subcutaneously as gallium citrate 20 mg amounts into a series of 12 rats in order to determine the distribution of the gallium. Similar experiments were performed with rabbits and dogs; in rabbits the excretion of the isotope was also investigated. It was found that in the rat, rabbit, and dog only bone and the kidneys receive large amounts of the element. Following the subcutaneous injection of the element as citrate, the rabbit excretes 30-55% of the total dose in the urine within 16 hr, while the osteoid structures absorb an additional 30-48% within this time. Definite amounts are also excreted into the stomach and intestines by the gastrointestinal mucosa; the contents of the tract contain 1-2% of the subcutaneous dose within 12-18 hr after injection.

1657 Toxic Fluorine Compounds Containing the C-F Link. Part VII. Evidence for the β-Oxidation of ω-Fluorocarboxylic Acids in Vivo. F. L. M. Pattison and B. C. Saunders. J. Chem. Soc., 2745-9(1949) Nov.

This study of the toxicity of fluorine compounds is based on the previous discovery that ω-fluoro-carboxylic esters of the general formula $F.(CH_2)_nCO_2R$ are very toxic to animals when n is an odd number, but nontoxic if n is even. The highly toxic γ-fluorobutyric acid has been "blocked" on the β position as in ethyl γ-fluoro-ββ-dimethylbutyrate and in α and β positions as in methyl 2-fluoromethyl-3:6-endomethylene-Δ^4-tetrahydrobenzoate and in the related compounds methyl 2-fluoromethyl-4:5-dimethyl-Δ^4-tetrahydrobenzoate, methyl 2-fluoromethyl-4:5-dimethylhexahydrobenzoate, and methyl 2-fluoromethyl-3:6-endomethylene hexahydrobenzoate. The

BIOLOGY AND MEDICINE

nontoxicity of these new fluoro-compounds affords additional support for β oxidation of ω-fluoro-carboxylic acids in vivo. (auth.)

1658 Toxic Fluorine Compounds Containing the C-F Link. Part VIII. ω-Fluoro-carboxylic Acids and Derivatives Containing an Oxygen Atom as a Chain Member. F. J. Buckle and B. C. Saunders. J. Chem. Soc., 2774-8(1949) Nov.

An oxygen atom has been introduced at selected points in the chain of certain fluorocarboxylic acids and their derivatives by a method depending ultimately upon the cyanoethylation of the appropriate fluoro-alcohol. These compounds, of the formula $F.(CH_2)_m.O.(CH_2)_n.CO_2H$, were examined pharmacologically by subcutaneous injection of the compound into mice. Methyl fluoroacetate was always injected under the same conditions as a control. The compounds studied were: beta-3-fluoropropoxypropionic acid (I), ethyl-2-cyanoethyl ether (II), 2-fluoro- (III), and 2-hydroxy-2′-2″-fluoroethoxydiethyl ether (IV), 3-2′ fluoroethoxypropylamine (V), ethyl-2-fluoroethoxyacetate (VI), and other derivatives. (I) was found to be quite toxic whereas beta-2-fluoropropoxypropionic acid was nontoxic. (II) was found to be nontoxic, showing that the toxicity of the fluorine analog is caused ultimately by the presence of the fluorine atom and not to another part of the molecule. (III) and (IV) were both toxic: the former had an LD-50 of 15-20 and the latter of 30-40 mg/kg. The LD_{50} of (V) was about 50 mg/kg. (VI) and its two butyric esters were nontoxic. No very precise conclusions were arrived at from the toxicity determinations. Further evidence for the process of β oxidation of acids was obtained, however. Several additional factors, apart from β oxidation, appear to be operating, owing to the presence of the ether linkage.

1659 In Vitro Transfer of Radioiron Across the Nucleated and Non-Nucleated Erythrocyte Membrane. L. M. Sharpe, P. S. Krishnan, and J. R. Klein. AECU-676, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Whole blood incubated in vitro with radioiron, as ferric ammonium citrate, overnight at 37°C showed increased accumulation of iron in the washed erythrocytes in the following ascending order; man, dog, rat, pigeon, duck. Addition of NaCN, final concentration 0.005M, inhibited the transfer almost completely.

The uptake of iron by duck erythrocytes was studied in some detail. Incubation of whole blood with radioiron resulted in a progressive increase in the radioactivity of the red blood corpuscles which reached a peak at 6 hr and then tended to decline somewhat when incubation was extended to 24 hr. Erythrocytes, which had taken up the optimum amount of iron following incubation, were separated from plasma, washed with saline, hemolysed, the debris removed, and the supernatant treated with trichloroacetic acid. Radioactivity measurements of cell debris, protein, and nonprotein fractions showed that about three-fourths of the total activity was associated with the protein fraction.

Uptake of iron and incorporation into protein occurred also if the radioiron was added after hemolysis of the cells, but was negligible if added to the centrifuged solution of the cell contents alone.

BIOLOGY AND MEDICINE

1660 The Reliability of the Bacterial Degradation of C^{14} Labeled Glucose. Martin Gibbs. AECU-695, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

1-C^{14} glucose, 3,4-C^{14} glucose and uniformly labeled glucose were fermented to lactic acid with Lactobacillus casei ATCC 7469 (Wood et al, J. Biol. Chem. 159, 475(1945)) to lactic acid which was then degraded in order to determine whether the amount and position of label in lactic acid produced by fermentation represents a true picture of the label within the glucose. In the case of 1-C^{14} glucose and 3,4-C^{14} glucose, about 5% of the label did not appear in the expected positions of lactic acid. Uniformly labeled glucose yielded lactic acid of the same specific activity as the glucose indicating that lactic acid fermentation involved only a cleavage of the 6-carbon glucose chain into two 3-carbon fragments. L. casei was not able to fix $C^{14}O_2$ indicating that the fixation reactions cannot explain the shift of label from the expected positions. The degradation of chemically synthesized lactic acid yielded the expected results. The length of time of the fermentation and the atmosphere (CO_2, nitrogen, air) under which the fermentations were carried out had no effect on the distribution of the label.

1661 Considerations of Renal, Hepatic, and Extremital Arteriovenous Differences in Concentration of Radiomercury of a Mercurial Diuretic. Pervis Milnor, George Burch, Thorpe Ray, Sam Threefoot, and Gerald Berenson. J. Clin. Invest. 29, 72-86(1950) Jan.

By the use of venous catheterization and a mercurial diuretic containing a radioactive isotope of mercury, $Hg^{203,205}$, it was possible to measure and compare the time course of the mercury of the diuretic in the renal or hepatic venous blood, extremital venous blood, arterial blood, and the urine of human subjects; from these figures was calculated the percentage extraction of mercury by the kidney, the extremities, and the liver. In five subjects, the renal extraction varied from 5-25% 10-90 min after the injection of the diuretic; in a control subject, the hepatic extraction varied from 5-10% during this period, but no hepatic extraction was detected in a subject with congestive heart failure. The concentration of $Hg^{203,205}$ in extremital venous blood was lower than in arterial blood until 10-20 min after injection, after which the two concentrations were essentially the same. A temporary decrease in urinary rate of volume flow was found to precede the usual mercurial diuresis; this decreased rate of flow coincided with the appearance of mercury in extremely high concentrations in the urine; the reciprocal relationship of the rate of urinary flow to the urinary concentration of $Hg^{203,205}$ tended to maintain the urinary rate of excretion of mercury at a fairly uniform level. The functional patterns for the two kidneys of the same subject were similar to one another. After stabilization, renal clearances of $Hg^{203,205}$ varied from 10-60 cc/min. The number of patients studied was too small to permit conclusions regarding differences in renal or hepatic handling of mercury by cardiac and control subjects and the studies were subject to several specified limitations. (auth.)

1662 Distribution of Radiophosphorus in Rabbit Tissues after Injection of Phosphorus-Labeled Diisopropyl

Fluorophosphate. Bernard J. Jandorf and Priscilla D. McNamara. J. Pharmacol. Exptl. Therap. 98, 77-84(1950) Jan.

When phosphorus-labeled DFP (diisopropyl fluoro-phosphate) was injected intravenously into rabbits (3-4 mc P^{32}/mM) radiophosphorus was retained in relatively large amounts by kidney, liver, and lung, while other organs took up only small or insignificant amounts; the specific retention of P^{32} was found to depend on the dose administered, and on the length of survival. It is stated that no correlation seems to exist between the cholinesterase activity of rabbit organs, and their ability to retain DFP-derived phosphorus; no significant retention of P^{32} in any tissue was found when labeled diisopropylphosphate was administered. Of the total amount of DFP-derived P^{32} retained in liver, lung, and kidney, a fraction which reached 100% after 4 hr of survival was bound to tissue proteins. In plasma of rabbits injected with labeled DFP, most of the P^{32} originally present was eliminated before regeneration of cholinesterase activity started. In erythrocytes the elimination of P^{32} was found to parallel the reappearance of cholinesterase, indicating the destruction of cells whose cholinesterase was inactivated by DFP and their replacement with new cells containing active esterase. (auth.)

1663 Equations for Tracer Experiments. A. K. Solomon. J. Clin. Invest. 28, pt. 1, 1297-1307(1949) Nov.

Some of the mathematical equations which govern the transfer of fluid from one portion of the body to another, and the synthesis of compounds in biological and physiological systems are presented in detail and related to their application in tracer experiments. Three basic assumptions are made: the tracer element follows its unlabeled isotope faithfully in all biological reactions; in systems of constant volume, the rate of flow of the isotope out of a compartment is proportional to the amount of labeled isotope present in the compartment; and, there is present uniform distribution of the isotope throughout the compartments. Equations for the following five different cases are derived: the simple decay state; the uptake from a constant source; the closed two-compartment system; diffusion or flow out of a compartment; and, the uptake of radioactive material in a three-compartment system. 21 references.

1664 Influence of the Pineal Body on the Variations of Rate of Exchange of Phosphorus in Certain Organs. Comparative Study. L. Thiéblot, J. Sternberg, and H. Le Bars. J. physiologie 41, 276-A-277-A(1949) (in French).

Since previous works have indicated the interrelationship between the pineal body and the sexual glands, the authors have undertaken to study the variation in the rate of utilization of phosphorus in certain organs, and in particular the genital glands. The concentration of phosphorus in these glands constitutes a precise indication of their functional activity, whether it is a question of nucleoproteids, or of phosphoaminolipids. In this work it was necessary to use radiophosphorus (in the form of a neutral solution of Na_2HPO_4) in order to determine the speed of utilization of exogenous phosphorus. The experiments were carried out on rats. Ablation of the pineal body in males (weighing about 50 g) was carried out according to a previously described technique (J. physiologie 39, 321(1947)). The animals were sacrificed after a delay of six to eight weeks after the ablation. The injection of the radiophosphorus was given 2 hr before the sacrifice of the animal. The following results were obtained: for the first series of experiments the total dosage of phosphorus gave a notable difference in the concentration of phosphorus in the testicles of the pinealectomized animals in comparison with that of the controls (980 μg/g for the controls; 2,600 μg/g for the experimental animals). Data given by the same dosage in animals which were subjected to hypophysectomy and epiphysectomy are 1,600 μg/g for the controls, and 440 μg/g for the operated animals. The concentration of P^{32}/g of tissue indicated that in the epiphysectomized animals, only the testicle and the liver presented an augmentation (110 μg/g as compared with 100 μg/g in the testicle and of 103 μg/g as compared with 100 μg/g in the liver). The other organs did not present notable variations. The results tend to show that the pineal body possesses a retarding action on the fixation of phosphorus in the testicles; an action which is exercised through the intermediary action of the hypophysis. This would be a new proof of the antagonism between the pineal body and the hypophysis.

1665 Introduction to the Study of Active Isotopes in Biology. L. Giuntoli. Asmara, Tipografia del Governo B.M.A., Eritrea, 1949. (Extract from the Bulletin of the Italian Society of Medicine and Colonial Hygiene).

Some of the chapters of interest in this book are concerned with stable isotopes, the separation of the isotopes, the characteristics of corpuscular radiation, constants of radioactive elements, deposition and methods for the bombardment of nuclei, production of active isotopes in the pile and in the cyclotron, unity of measurement, validity and significance of isotopes in biological research, ideas and theories on the more common radio-elements, isotopic methods of biological research and radio-elements in therapy.

1666 The Metabolism of Iodine Compounds. William T. Salter, Gopal Karandikar, and Paul Block. J. Am. Pharm. Assoc., Sci. Ed. 38, 626-41(1949) Dec.

The fates of iodine and iodine compounds within the human body were studied with the aid of radioactive iodine, I^{131}. From the numerous and detailed observations, it was concluded that whenever an organic compound is administered to a mammal, varying amounts of iodide are liberated by decomposition; drugs like thyroxine are completely degradated down to the iodide ion alone. The organic iodine compounds are resolved into two great classes for discussion: those connected with the internal economy of the thyroid; and, those which are more strictly pharmaceutical in nature. In the first group, along with iodide, the chief compounds considered are diiodotyrosine and thyroxine; the latter group is extensive and is distinguishable by the tendency to concentrate in the liver and kidneys, creating a radio-opaque effect as an aid to diagnosis and to the identification of areas and organs. Careful and extensive studies on the pharmaceutical effects of iodine incorporation into organic molecules are indicated. 44 references.

1667 Metabolism of Radioactive Elemental Sulfur Applied to Lemons as an Insecticide. F. M. Turrell and

BIOLOGY AND MEDICINE

Marcella Chervenak. Botan. Gaz. 111, 109-22(1949) Dec.

Isotopic sulfur (S^{35}) was mixed with nonradioactive elemental sulfur and applied to two sets of 28 freshly-picked, ripe, yellow Eureka lemons in order to determine the metabolism of sulfur when used as an insecticide; the methods and technique used for the determinations are described. It was found that a very large proportion of the sulfur present in the H_2S (which was formed when lemons were dusted with elemental sulfur and incubated at warm temperatures) was derived from the sulfur applied as a spray. The sulfate (formed in the fruit peel) may also be derived from the sulfur applied as a spray if relatively large amounts are present; elemental sulfur vapor penetrates the lemons and radioautographs suggest that it is incorporated into the tissue proteins. 89 references.

1668 A Method of Measuring the Rate of Exchange of Sodium Between Plasma and Extravascular Liquids in the Rabbit with Radiosodium. F. Morel and M. Marois. Arch. sci. physiol. 3, 15-26(1949)(in French).

Numerous samples of blood have been taken from the rabbit during the 5 min following the intravenous injection of a solution of radiosodium (1 cm^3 of 0.7% Na*Cl/kg rabbit). The curve relating the concentration of radiosodium in the plasma (expressed in mg of radiosodium/cm^3) to time, decreases exponentially. From this curve it is possible to calculate the capillary permeability of sodium as a function of the volume of circulating blood and the interstitial spaces involved in the phenomenon. The therm of sodium space also is discussed. For the rabbit the circulatory distribution of radiosodium is completed 40 sec following the injection. The concentration of radiosodium in the plasma attains equilibrium after 5 min. The volume of circulating plasma is found to be equal to about 5-8% of the body weight. During the early part of equilibrium period the volume of liquids between which the radiosodium is divided is equal to 16-20% of the body weight. The capillary permeability of the sodium is given by the formula

$$P = \frac{2.30\ K\ na_1 na_2}{Na}$$

where: K = 2.30 × rate of exponential decrease (calculated graphically)

Na = total quantity of sodium contained in body liquid (plasma plus extravascular)

na_1 = total quantity of sodium contained in plasma

$na_2 = Na - na_1$

the authors have found P = 2.2 mg of sodium/sec/kg for the rabbit. (auth.)

1669 Radioactive Phosphorus in Studies on the Metabolism of Normal and Neoplastic Tissues. A. Marshak. J. Clin. Invest. 28, pt. 1, 1324-9(1949) Nov.

A review is presented concerning the applications of radioactive phosphorus to the study of phosphate esters and carbohydrate metabolism, nucleic acids, and nucleoproteins, nucleic acid turnover in relation to mitosis, the x-ray effects on nucleic acid turnover and the deposition of elements in bone. 44 references.

BIOLOGY AND MEDICINE

1670 Studies in Calcium Urinary Excretion with the Aid of Radiocalcium. J. Govaerts. Am. J. Physiol. 159, 542-6(1949) Dec.

Radioactive Ca^{45}, with a half-life of 180 days, was used in tracer studies on dogs concerning urinary excretion of calcium. The animals received intravenously, labeled calcium chloride solutions containing 0.373-90 mg Ca and about 0.310 counts/min of Ca^{45}. Before and immediately after administration of the calcium solution, blood samples were taken and small samples of urine were collected. Radioactive measurements showed that exogenous calcium, unlike phosphate, is excreted into the urine in proportion to its abundance in plasma as a percentage of the total Ca in the latter system. The percentage of exogenous phosphate found in urine exceeds that for plasma. (auth.)

1671 Thirty-fourth Annual Meeting of the Ecological Society of America, Held on Dec. 27-30, 1949 at New York. Bull. Ecol. Soc. Am. 30, 54, 58, 65(1949) Dec.

Among the papers presented were the following: Use of Radio Isotopes in Ecological Research, Dale W. Jenkins. Radioisotopes as Tools for the Study of Animals Under Natural Conditions, Donald R. Griffin. Peat Samples and the Radiocarbon Chronology, E. S. Deevey, Murray Buell, H. C. Darlington, D. G. Frey, J. E. Potzger, and E. S. Stone. In the first paper suggestions and a brief review of the use of available radio isotopes suitable for ecological research were presented, together with techniques of applying, and methods of detection including instruments and radioautographs. The unusual advantages and certain limitations of the use of radioisotopes were discussed in relation to ecological research on predation, parasitism and mutualism, dispersal including flight range, migration and pollination, behavior of individuals in nocturnal, subterranean, and aquatic habitats, life history studies, reproduction, longevity, and other problems. In the second paper, the use of radioisotopes as tools in studying the movements and activities of individual animals with the minimum of restraint was described. Small radioactive tagging of homing pigeons was utilized in connection with a recording machine to determine the exact time of return to their nests after release from a distant point. The calculation of efficient and safe dosages were discussed with a view to the application of the method to a variety of problems involving the behavior of animals under natural conditions. In the third paper, a method for calculating postglacial chronology from the C^{14} content of fossil organic matter is discussed; the techniques of sampling and other difficulties are outlined.

1672 Thyroid Function in Mental Disease Measured with Radioactive Iodine, I^{131}. Karl M. Bowman, Earl R. Miller, Morris E. Dailey, Alexander Simon, Berdeen Frankel, and Genevieve W. Lowe. Am. J. Psychiatry 106, 561-72(1950) Feb.

A report of a study in progress on the thyroid function in patients with mental diseases is presented; the report includes data concerning the uptake of the I^{131} by the thyroid gland, the serum-bound protein, basal metabolic rate, and plasma cholesterol in 36 patients. A test dose of 150 μc of the isotope in 30 cc of water was given to each subject orally, and during the next 72 hr 5-6 determinations of the

concentration of I^{131} were made; the I^{131} uptake test was repeated at various intervals after the administration of various types of therapy, such as the insulin shock, electroshock, electronarcosis, and psychotherapy. The authors state that only the schizophrenic patients treated represent a group sufficiently large to evaluate. It was found that in most of the patients the average basal metabolic rates were somewhat low, while the average plasma cholesterols were somewhat high; the serum protein-bound iodine concentrations fell within the normal range and the uptake of I^{131} was generally normal. No change in thyroid function in the patients was noted during or after the various therapeutic treatments given them. The results of the study of other types of psychoses will be reported at a later date. 23 references.

1673 Tracers Come of Age. Milton Nelson. Iowa Agriculturist 48, 12-14(1949) Dec.

It is noted that, although radioactive tracers do not appreciably affect the rate of plant growth, they provide a useful tool in soil and fertilizer research. Tracer techniques have been used to study the absorption of phosphorus from fertilizer, and to study the history of CO in plant physiology. This latter work is still under way at Iowa State University.

1674 Tracers in Plant Growth. R. Scott Russell. Countryman 40, 295-9(1949) Winter.

A general discussion is presented on the nature of radioisotopes and the indications for their use as tracers in biology; some of the uses for the tracers are the determinations of the rates of utilization of the elements from the soil and the rates of the movements of the elements within the plants which absorb the elements from the soil. The author concludes that radioisotopes are very useful tools in the hands of capable investigators, but such problems as the danger of destruction of the experimental subjects from their radiations and the difficulties in point localization of their concentrations are to be overcome. One of the attractions of tracer research is that it is a team enterprise, requiring the cooperation of both the physicist and the biologist.

1675 The Use of Isotopes as Metabolic Tracers. DeWitt Stetten, Jr. Ann. Internal Med. 32, 1-5(1950) Jan.

A brief discussion of the advantages obtained by the use of isotopes of such elements as carbon, hydrogen, nitrogen, oxygen, sulfur, phosphorus, iodine as tracers for such studies as the anatomical distribution of a substance, the biological precursors and derivatives of a substance, the rate of utilization and turnover of a body constituent in the organism while in a "steady state," and the changes in normal reaction rates under abnormal conditions is presented. It is concluded that the use of these isotopic tracers in intermediary metabolism research is a valuable adjunct to the other techniques of biochemical investigation and especially permits a more powerful and direct application to biological problems of the methods of synthesis and analysis. 15 references.

1676 The Use of Isotopes as Tracers in Biology. A. F. Graham. Can. J. Comp. Med. Vet. Sci. 13, 310-11 (1949) Dec.

The nature and use of radioisotopes are discussed, and their role as tracers in biological investigations is presented.

BIOLOGY AND MEDICINE

Two advantages of the tracers are: the ability to distinguish the injected, or otherwise administered, labeled material from that already present in the organism to be studied; and, the ability to distinguish with tracer techniques the presence of very small quantities of the labeled material in the part under study and to make quantitative estimations. The choice of a suitable isotope involves a knowledge of the half-life energy and the type of radiation emitted by the isotope. If the isotope is to be administered as part of a complex organic compound, the synthesis is frequently laborious and difficult.

1677 The Use of Radioactive Phosphorus in the Study of the Teeth of Caries-Resistant and Caries-Susceptible Strains of Albino Rats. Carl A. Hoppert and Ray L. Shirley. J. Dental Research 29, 29-37(1950) Feb.

In this investigation a comparison of the rates of deposition and removal of P^{32} in teeth of two inbred strains of albino rats (caries-resistant and caries-susceptible) and stock colony rats was made; weight, ash content, phosphorus content expressed as percent of dry weight of the teeth and of the ash, rates of deposition and removal of P^{32} after intraperitoneal injection of the isotope, occurrence of P^{32} in the teeth of offspring whose mothers were injected intraperitoneally during pregnancy, and absorption of the P^{32} from aqueous solution were factors utilized for the comparison. The rats were maintained on a cariogenic ration of finely ground rice; 1 ml of the P^{32} (containing 15-20 μc) was injected into the peritoneal cavity of the rats at 20 and 35 days of age. At intervals of a few hours to 40 days after the administration the animals were sacrificed, the teeth removed, cleaned and ashed and their radioactivity was determined. The two strains of albino rats showed slight variations in the weight of teeth, per cent ash in the molars and per cent phosphorus in the molars. 12 references. (auth.)

1678 The Use of Radioiodine in Physiological and Clinical Studies on the Thyroid Gland. M. S. Raben and E. B. Astwood. J. Clin. Invest. 28, pt. 1, 1347-66 (1949) Nov.

An extensive summary and review is presented on the use of radioiodine in physiological and clinical studies on the thyroid gland. Evidence for the physiological identity of radioiodine and I^{127}, absorption, distribution, and excretion of the iodide ion, the concentration of the iodide ion by the thyroid, organic binding and hormone synthesis, hormone secretion, factors influencing the rate of hormone formation and discharge, the fate of thyroxine in the body and radioiodine in clinical investigation and diagnosis are some of the topics discussed in this report. 134 references.

1679 Variations in the Distribution of Radioactive Phosphorus Produced by Activity in Peripheral Nerves. G. Causey and G. Werner. Nature 165, 21-2(1950) Jan. 7.

The results of two experiments determining the distribution of P^{32} in the sural nerve and in the nerve to the medial head of the gastrocnemius muscle of rabbits are presented. In the first experiment, six of the rabbits were anesthetized with urethane or Nembutal intravenously, and after 30 min 1 ml of radioactive disodium hydrogen phosphate (containing

BIOLOGY AND MEDICINE

30-60 μc of P^{32}) was injected intravenously; 20 min later the nerves were excised, divided into three approximately equal parts, ashed separately and tested for radioactivity. In the sural nerve there was a marked change in the concentration of P^{32} in the three parts, (the proximal part containing 37% more than the distal) and in the gastrocnemius nerve there was a 50% rise in the distal portion. In a second experiment eight rabbits were anesthetized with urethane, P^{32} was injected intravenously, and stimulation by pricking with a needle the area of the skin supplied by the sural nerve on the lateral and posterior aspects of the ankle was begun at once and continued for 20 min; the stimulus was controlled to elicit a withdrawal reflex. The nerve on the unstimulated side showed no P^{32} gradient whereas on the stimulated side there was a marked diminution of the P^{32} distally. Subsequent investigations on the distribution of red blood corpuscles tagged with P^{32} showed that different parts of the nerves contained substantially the same content of the corpuscles before and after anesthesia and stimulation. It is said in conclusion that these experiments indicate that the distribution of P^{32} in the peripheral nerves of the resting, anesthetized rabbit tends to be uniform, but a distinct gradiant may be found when the animal is moving spontaneously or the sensory end organs of the skin are stimulated mechanically; the gradiants are opposite in nerves carrying cutaneous sensation fibres and motor nerves.

1680 The Zone of Localization of Antibodies. IV. The in Vivo Disposition of Anti-Mouse-Kidney Serum and Anti-Mouse-Plasma Serum as Determined by Radioactive Tracers. David Pressman. J. Immunol. 63, 375-88(1949) Dec.

Antisera were prepared in rabbits against kidney tissue and plasma from the Akm strain of mice and against ovalbumin. The globulin fractions of these sera were radioiodinated with I^{131} and injected into mice of several strains and into rats. It was found that radioactivity localized in the kidneys of the animals receiving the antikidney serum, but not in the kidneys of those receiving the antiplasma serum or antiovalbumin serum; radioiodide also showed no such localization. This demonstrated to the author that there was some material, presumably antibody molecules, in the antikidney serum and not in the control sera, that localized in the kidney. The localization of antikidney serum was not strain specific since it took place in mice of other strains. It also took place on the injection of rats with the anti-mouse-kidney preparation. The duration of the radioactivity in the kidneys of the mice receiving the antikidney serum was measured over a period of 54 days and the radioactivity carrier, presumably the radioiodinated antibody, had a half life of 20 days. The half lives of the radioactive carriers in other tissues were blood, 2.3 days; spleen, 2.6 days; and thyroid 6.8 days. (auth.)

CHEMISTRY

1681 A Guide to Russian Scientific Periodical Literature. Spencer C. Stanford. AECU-701, Sept. 19, 1949. 7p.

The availability and means of acquisition of Russian periodical literature are discussed.

CHEMISTRY

1682 Theoretical Calculations of the Stability of Solid and Gaseous Species in the Alkali and Alkaline Earth Oxide Systems. Leo Brewer and Donald F. Mastick. UCRL-533, Nov. 1949. 33p.

Normal ionic bonding is assumed to exist between the atoms in the gaseous alkali halides, alkali oxides, and alkaline earth sub-oxides as well as for the solid state of the last species. The empirical repulsive function suggested by Born (Seitz, F., The Modern Theory of Solids, Chap. II.) and the values of the repulsive exponent given by Pauling (Nature of the Chemical Bond, Chap. X.) are applied in the calculation of the heat of formation of the gaseous and solid oxide species mentioned. In order to establish empirically a function which appears to represent the repulsive contribution to the bonding energy of these gaseous species, variations of the repulsive exponent are introduced into the theoretical calculation for gaseous species whose thermochemical heats of formation are known. To substantiate the assumption of ionic bonding in the gaseous species, the lattice energy of the alkali oxides and alkaline earth oxides are calculated theoretically assuming complete ionic bonding and compared to the value of the lattice energy obtained from experimental data by use of the Born-Haber cycle. When these methods are applied to the gaseous alkaline earth oxides it is found that the simple Born expression does not afford a good fit to the known bond energies if the cation and anion are assumed to be doubly charged. Actually, a closer fit is obtained if the repulsion is assumed to be negligible and further, that the cation and anion are singly charged. From an investigation of the results of these calculations and the findings of Bridgman (Rev. Mod. Phys. 7, 1(1935)) in high pressure researches it is concluded that in such molecules where the mutual penetration is high, because of the large coulombic force arising from doubly charged ions, the simple repulsive "law of force" such as given by Born no longer applies. Bridgman (ibid) comes to the same conclusion in studying ionic compressions due to externally applied pressure; namely, that the simple functions of the distance between the ions are a good empirical fit over a short range of the distance and fail badly when applied to extreme cases. This is the situation which obtains in the case of the alkaline earth oxides. The Born expression affords a good fit in the solid state since the equilibrium interionic distances do not involve extreme interpenetration by virtue of the semi-infinite lattice of positive and negative charges about any one ion. In the gaseous state, however, only the coulombic force between the cation and anion is acting, which leads to a much closer approach of the two ions relative to that in the solid state, as is actually shown from the spectroscopically determined bond distance. Thus, calculations using the methods developed herein cannot be made for gaseous molecules whose bonding is coulombic resulting from charges on the ions of magnitude 2 or greater since the repulsive "law of force", which is the basis of the theory, presumably does not apply to these systems. (auth)

1683 Analysis by Nuclear Transmutation. Wolfgang Riezler. Z. Naturforsch. 4a, 545-9(1949) Oct. (in German).

Investigations are reported concerning the detection of small amounts of impurities in carrier metals by means of

CHEMISTRY

irradiation with deuterons. For the detection of carbon impurities in iron deuteron energies of about 4 Mev were found to be most suitable. The smallest amount of a given impurity detectable depends strongly on the amount of other impurities also present. It was found that very small amounts of silicon or sodium in aluminum can be detected. For silicon the limit of detection is ~0.001%.

1684 Periodic Law of Atom Nuclei. Isotopes Near the End of the Periodic Table. A. P. Znoĭko. Doklady Akad. Nauk S.S.S.R. 69, 169-71(1949)(in Russian). (See also NSA 4-1386 and 1387.)

This is a third note on the author's "periodic system of nuclei" (see Doklady Akad. Nauk S.S.S.R. 68, 837 and 1021 (1949)), in which all isotopes, arranged according to coordinates Z/A and A, can be connected by various lines revealing regularities that concern half-lives, radioactivity, etc. In the present note, a detailed chart of that kind is given for elements with $Z \geq 79$. Several examples illustrate the possibility of predictions concerning unknown long-living isotopes and elements, such as U^{236}, Pu^{242}, 97^{247}, 98^{250}, 99^{251}, and 100^{254}.

1685 Dissociation and Exchange Equilibria of the Tritium Halides. Jacob Bigeleisen. AECU-674, nd. 25p.

The ratios of the partition functions of the tritium halides to their respective hydrogen halides have been calculated. These are combined with one another to give the exchange equilibria between the six pairs of tritium and hydrogen halides. The exchange equilibria with water are calculated. From the exchange equilibria between the tritium halides and hydrogen and the free energy of dissociation of the hydrogen halides, the dissociation equilibria of the tritium halides have been calculated. The experimental data on the dissociation of HI are reviewed, and it is shown that the data of Taylor and Crist (J. Am. Chem. Soc., 65, 1377(1941)) on DI and HI are self-consistent as well as in good agreement with theory. The heat of formation of HI at absolute zero is found to be -1007 ± 10 calories per mole. (auth)

1686 Fractionation of Chlorotrifluoroethylene Liquid Polymer. N. C. Orrick. K-533, Dec. 16, 1949. 13p.

A sample of chlorotrifluoroethylene liquid polymer was fractionated in a Bowman vacuum rotary still to obtain polymer fractions suitable for the determination and correlation of physical properties. Results show much better separation than had previously been attained with a falling film type molecular still. The Bowman still and its operation are described. (auth)

1687 The Fluorination of Trimethylamine. J. Thompson and H. J. Emeléus. J. Chem. Soc., 3080(1949) Nov. (Note).

The vapor-phase fluorination of trimethylamine has been investigated by passing the vapor in a stream of nitrogen over a bed of cobaltic fluoride at temperatures ranging from 130 to 220°, and at atmospheric pressure. The issuing product was passed over sodium fluoride to remove hydrogen fluoride produced by the reaction and through a trap cooled with liquid air. The condensate was then introduced into a vacuum system for examination by trap-to-trap distillation and fractional condensation. The product was a complex mixture, the components boiling from about −120 to 120° and having molecular weights ranging from about 70 to 310. Under the reaction conditions investigated one component of molecular weight 171 was found to constitute 40-70% of the condensate in the cooled trap and has been identified as the bistrifluoromethylnitrogen monofluoride (perfluorodimethylamine), $N(CF_3)_2F$.

1688 Organic Fluorides. Part I. Fluorination of Hydrocarbons. W. K. R. Musgrave and F. Smith. J. Chem. Soc., 3021-6(1949) Nov.

An apparatus is described for the direct fluorination of hydrocarbons to give fluorocarbons (perfluorocarbons) by a vapor-phase catalytic method. Reference is made to the necessary conditions for successful fluorination. Copper and silver, which act as catalysts in fluorination, are believed to participate to some extent in the formation of higher fluorides as halogen carriers. The large metal surface offered by the catalyst also dissipates the heat of the reaction and reduces decomposition. The fluorocarbons are unique in the field of organic chemistry. Composed of carbon and the most electronegative element fluorine, they display a stability approaching that of the so-called rare gases. These substances display remarkable physical properties. Except with respect to density there is little resemblance between fluorocarbons and other halogen derivatives of carbon. (auth.)

1689 Studies on Trifluoroacetic Acid. Part I. Trifluoroacetic Anhydride as a Promoter of Ester Formation Between Hydroxy-compounds and Carboxylic Acids. E. J. Bourne, M. Stacey, J. C. Tatlow, and J. M. Tedder. J. Chem. Soc., 2976-9 (1949) Nov.

The production of esters from alcohols and phenols by treatment with carboxylic acids in the presence of trifluoroacetic anhydride is described. The method can be used to esterify carboxylic acids in both the aliphatic and aromatic series. In many cases the reaction proceeds spontaneously and is essentially complete within a few minutes. The general conditions of the reaction are relatively mild and enable, for example, acyl derivatives to be prepared in good yield from acid-labile glycosides. The method is particularly convenient for the acetylation and benzoylation of polysaccharides and also for the production of polyesters. (auth)

1690 Symposium on Fluorine Chemistry. C. E. Sunderlin. Office of Naval Research, London Branch, Technical Report No. OANAR-52-49, Dec. 13, 1949. 16p.

A Symposium on "Fluorine Chemistry" was held in London on November 30 under the auspices of the Chemical Society. Particular interest was shown in the chemical reactions of fluorine derivatives of the other halogens. These included ClF_3, BrF_3, and IF_5. Nitronium compounds of the general formula NO_2MF_x have been prepared. These have possible application as nitrating agents. Short chain tetrafluoroethylene polymers have been obtained by the reaction of CF_3I with tetrafluoroethylene. These polymers give straight chain free radicals on irradiation. Reactive mercury, phosphorus, and sulphur derivatives have been prepared which contain

trifluoromethyl radicals. Von Wartenberg's value for the dissociation energy of the fluorine molecule ($D(F_2)$ = 63.5 kcal/mole) has been critically reviewed. The experimental data available at present indicate a value of $D(F_2) = 36 \pm 8$ kcal/mole. (auth)

1691 An Improved Method of Directing Liquid Flow in a Closed System. L. G. Stang, Jr., and G. J. Selvin. AECU-689, Oct. 1, 1949. 6p.

A similar report (BNL-29) entitled "Hot Laboratory Technical Report. III. A Totally Sealed Rotating Funnel," by Gerald J. Selvin, has been listed in Nuclear Science Abstracts as Abstract No. 4-1392.

1692 A Semi-Automatic Injection Apparatus for Use with Radioactive Solutions. Margaret W. Holt. AECU-690, nd. 4p.

In connection with the handling of highly radioactive or other dangerous materials it is sometimes desirable to inject solutions into test animals by remote control. The apparatus described in this report affords a means of holding the skin of the animal in position while a hypodermic needle is automatically inserted. The apparatus is suitable for use with remote control devices, and it has the advantage that preliminary anesthetization or complete immobilization of the animal is not essential. The operation of the instrument is described in detail. Preliminary tests were made on the shaved belly of the rat. The apparatus was found to work very successfully if a sharp needle of the proper size was used. By connecting a suitable extension rod to the plunger of the syringe, injections could be made at considerable distances from the test animal. With slight modification (proper adjustment of the external length of needle) intraperitoneal injections were possible.

1693 A Low-Powered Induction Heater for Laboratory Use, Model HE-1 (Final Report). R. L. Shipp, Jr. MLM-399, Nov. 16, 1949. 16p.

A small portable induction heater with the following preliminary requirements has been developed: sufficient power to heat a small diamagnetic or ferromagnetic metal load to a temperature of 150°C in about 10 min (load normally enclosed in a partially evacuated glass tube); power output controllable over the operating range by a stepless control; the work coil connected to the heater by 3 or more ft of flexible transmission line so that the work coil could be located in a hood, and the heater on the outside. The heater was developed with the following additional features: power output well in excess of the requirements; a Variac used to provide stepless output control; the work coil can be located at least 12 ft from the exciter unit; the heater is small and flexible; the efficiency of this system is greater than for other systems investigated. Test results are included.

1694 Chemical Effects Accompanying the Decay of Mn^{51}. W. H. Burgus and J. W. Kennedy. J. Chem. Phys. 18, 97-105(1950) Jan.

An investigation has been made of the chemical forms assumed by Cr^{51} when it is produced by positron decay of Mn^{51} under a variety of conditions. The data have shown that the oxidation state of the parent Mn^{51} plays an important role in determining the oxidation state of daughter Cr^{51}. By variation of experimental conditions some information has been obtained regarding the types of chemical reactions undergone by the Cr^{51}. These reactions have also been shown to play important roles in determining the ultimate chemical form of daughter Cr^{51}. The complexity of the factors determining the chemical forms of Cr^{51} after Mn^{51} decay has been pointed out, and possible explanations of some of the observed phenomena have been suggested. The results are consistent with the hypothesis that appreciable ionization in the valence shell accompanies the β-decay process. Incidentally, it has been demonstrated that the manganese isotope of 44-min half-life (Mn^{51}) decays to the chromium isotope of 26-day half-life (Cr^{51}). (auth.)

1695 The Deamination of Glycine by α-Radiation from the Disintegration of Boron in a Nuclear Reactor. W. M. Dale, J. V. Davies, and C. W. Gilbert. Biochem. J. 45, 543-6(1949).

The deamination of glycine by the densely ionizing particles from the disintegration of boron by slow neutrons in a nuclear reactor was studied; an account of the necessary technique is given and the dosimetry is fully discussed. The ionic yields for the liberation of ammonia were 0.17 and 0.56 for the 1 and 20% solutions of glycine, respectively, being 15 and 19% of that due to x-radiation. The higher efficiency of deamination by this radiation compared with the inactivation of an enzyme by α rays from radon and its products is discussed. (auth.)

1696 Quantitative Studies of Radiation-Induced Reactions in Aqueous Solution. I. Oxidation of Ferrous Sulfate by X- and γ-radiation. Nicholas Miller. J. Chem. Phys. 18, 79-87(1950) Jan.

A study has been made of the oxidation of ferrous ions in 0.8N sulfuric acid solution by x and γ radiation in different types of system and using different energies of incident radiation. The conclusion is reached that simple modes of dosimetry, such as have been used in previous determinations of the ionic yields for a number of reactions induced by radiation in aqueous systems, are adequate if accuracy within 20% is all that is required. For greater precision, more rigorous methods have to be adopted, and using such a method, the ferrous sulfate system has been calibrated with a view to its possible use as a mode of integral dosimetry for aqueous media. Some speculations as to the mechanism of this particular reaction are included. (auth)

1697 The Association of Cerous Ion with Sulfite, Phosphate, and Pyrophosphate Ions; Interim Report. Stanley W. Mayer and S. David Schwartz. AD-171, Oct. 12, 1949. 19p.

The association constants for $CeSO_3^+$, $CePO_4$ and $CeP_2O_7^-$ have been measured by the ion exchange technique and found to be 1.1×10^8, 3.4×10^{18}, and 1.4×10^{17}, respectively. Theories of complex formation are discussed in relation to the experimental results.

1698 The Separation and Purification of Lanthanum. Part I. Hydroxide Precipitation. R. C. Vickery. J. Chem. Soc., 2506-8(1949) Oct. (See also NSA 4-1106.)

CHEMISTRY

The application is studied of the air-borne ammonia separation of lanthanum. It is found that this method provides for very good separation, and at high concentrations of ammonium ions the introduction of cadmium into the system is not necessary. (auth.)

1699 The Preparation of C^{14} Uniformly Labeled Fructose by Means of Photosynthesis and Paper Chromatography. Sidney Udenfriend and Martin Gibbs. AECU-699, nd. 5p.

Highly active fructose in a very pure form has been prepared from bean leaves by using a one-dimensional paper chromatogram with phenol as the solvent. The fructose was labeled with C^{14} by allowing the bean leaves to photosynthesize in the presence of $C^{14}O_2$.

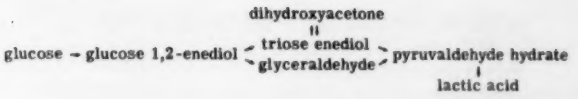
1700 Electronic Exchange and Oxidation-Reduction Reactions in Inorganic Systems. J. W. Gryder. AECU-683, nd. 8p.

Oxidation-reduction reactions can be defined in general as reactions in which electrons are donated to an oxidizing agent by a reducing agent. On this basis the transfer of electrons between two oxidation states of a single element can be considered to be a very simple form of oxidation and reduction. Such reactions are commonly known as electronic exchange reactions and can be studied by the use of radioisotopes. This paper is concerned only with reactions in which there is hope that no very great rearrangement of atoms occurs between the initial and final states of the oxidizing or reducing agent. The results of some measurements reported in the literature are summarized and discussed. It is concluded that the following factors are most important in determining reaction rates in oxidation-reduction systems: (1) The nature of the species undergoing change — (a) The presence of complexing agents which form new potentially oxidizable or reducible species with different spacial arrangements and free energies and (b) The electronic state of the ions involved. (2) Conditions that will cause different species to exchange at different rates — (a) Free energy change of the reaction involved; (b) The charge product of the reacting ions; and (c) The electrical properties of the solution, determined chiefly by the ionic strength and dielectric constants.

1701 On the Mechanism of the Chemical Formation of Lactic Acid from Glucose Studied with C^{14} Labeled Glucose. Martin Gibbs. AECU-687, nd. 5p.

The mechanism of reaction proposed by Evans (Chem. Rev. 31, 537(1942)) has been tested with the aid of C^{14}-labeled glucose. In agreement with this theory, the action of 3N KOH on 1-C^{14}-D-glucose gave an equal distribution of label in the carboxyl carbon and β carbon of lactic acid. However, the action of 3N KOH on 3,4-C^{14}-D-glucose yielded more activity (2.4 : 1) in the carboxyl carbon than in the β carbon of lactic acid. This was not in agreement with the theory of Evans (ibid). It is proposed that carbon atoms 4,5, and 6 of glucose which form the glyceraldehyde do not go through a symmetrical molecule during their conversion to lactic acid, but go intact to pyruvaldehyde hydrate. The following modification to Evans' reaction mechanism results:

CHEMISTRY



1702 A Preliminary Report on the Mechanism of the Decomposition of Diacetyl Peroxide in Acetic Acid. A. J. Fry, B. M. Tolbert, and Melvin Calvin. UCRL-573, Dec. 29, 1949. 14p.

Tracer studies have been made of the decomposition of diacetyl peroxide in acetic acid-2-C^{14}. The activity of the products in general confirms the mechanism of the reaction as proposed by Kharasch and Gladstone (J. Am. Chem. Soc. 65, 15(1943)), in which the reaction products are succinic acid or its derivatives, methane, carbon dioxide, and some methyl acetate. However, the presence and distribution of activity in the methyl acetate produced in this reaction is not explained by the previously proposed mechanism. There was found to be no appreciable exchange of acetic acid and diacetyl peroxide under the conditions of the reaction. Essentially no exchange of methyl acetate and acetic acid was observed when those reagents were heated at 100° for 5 hr.

1703 The Role of Formaldehyde and Formic Acid in the Preparation of Demerol-N-Methyl-C^{14}. Winifred Tarpey. UCRL-563, Dec. 29, 1949. 10p.

Demerol (the hydrochloride salt of 1-methyl-4-phenyl-4-carbethoxy-piperidine) has been synthesized, labeled with C^{14} in the N-methyl position, by use of formaldehyde-C^{14} in the Wallach reaction (Staple and Wagner, J. Org. Chem., 14, 559(1949)). The use of formaldehyde-C^{14} in one reaction and formic acid-C^{14} in another has shown that under the conditions of the reaction formaldehyde is the source of the N-methyl group formed, reduction is affected only by the formic acid, and there is no exchange between the formic acid and formaldehyde. (auth)

1704 Chain Initiation in Styrene Emulsion Polymerization. Wendell V. Smith. J. Am. Chem. Soc. 71, 4077-82(1949) Dec.

The rate of the initiation step in styrene polymerization has been investigated by a method based on the observation that fragments of the chain initiator, persulfate, are chemically combined with the polymer. The method consisted of determining how rapidly these fragments become combined by measuring the rate of polymerization and the radioactivity of polystyrene prepared using radioactive persulfate (containing S^{35}) as initiator. The rate of persulfate combination from radioactivity measurements, the initial rate of polymer particle formation from polymer particle size measurements, and the rate of molecule formation from molecular weight measurements have been obtained for styrene emulsion polymerization, and all three quantities agree within an order of magnitude. This indicates that all three are determined principally by the rate of formation of free radicals. The rate of free radical formation does not appear to depend on the interfacial area between organic and aqueous phases. (auth.)

1705 The Constitution of Complex Metallic Salts. Part XIV. The Action of Trialkyl-phosphines and -arsines

CHEMISTRY

on the Tetrahalides of Tin and Uranium. John A. C. Allison and Frederick G. Mann. J. Chem. Soc., 2915-21(1949) Nov.

Trialkyl-phosphines and -arsines combine with stannic chloride and bromide to give covalent compounds of type $[(R_3P)_2SnCl_4]$ and $[(R_3P)_2SnBr_4]$; the corresponding tetraiodo-analogues could not be isolated as stable compounds. The structure of "bridged" derivatives of composition $[(R_3P)_2SnCl_4, HgCl_2]$ and $[(R_3P)_2PdCl_2, SnCl_4]$ which have been isolated is discussed. Trialkylphosphines combine with uranium tetrachloride and tetrabromide to give similar covalent derivatives $[(R_3P)_2UCl_4]$ and $[(R_3P)_2UBr_4]$, but no indication of the formation of analogous trialkylarsine derivatives was obtained. The salt, tris-2: 2'-dipyridyl-uranium hexathiocyanate, $[dpy_3U](SCN)_6$, is described as hygroscopic compact yellow crystals or as hexagonal plates which slowly become opaque on exposure to air, apparantly with the formation of the monohydrate. (auth.)

ENGINEERING

1706 Periodic Heat Transfer by Radiation through Layers in a Vacuum. Fred L. Whipple and J. Orten Gadd. AECU-705(HUX-6), Dec. 1949. 16p.

In a newly developed theory for the nature of comets there arises a problem of heat transfer by radiation, the differential equations for which require numbeical integration. There also enter several constants which may take on very large or very small values. An effort is made herein to obtain approximate results in several different cases, in the hope that these approximations may point out more clearly the cases of special interest. The cases considered are for layers of zero heat capacity and finite heat capacity, respectively.

1707 On the Vacuum Properties of Silastic. G. D. Adams and W. C. Sherwin. Rev. Sci. Instruments 20, 957-8(1949) Dec. (Laboratory and shop note).

The authors have independently investigated the vacuum properties of Dow-Corning Silastic rubber. Some attention was given to each of Silastic Nos. 122, 123, 125, 126, 150, and 160. The conclusion was reached that the material is not useful for vacuum below 10^{-5} mm Hg without very special precautions. It has a fairly high vapor pressure and the body is not completely impermeable.

MINERALOGY, METALLURGY AND CERAMICS

1708 Some Preliminary Investigations of Quantitative Interpretations of Radioactivity Logs. Robert E. Bush and E. S. Mardock. Petroleum Technol. 2, 19-34(1950) Jan.

The basic theories underlying the operation of radioactivity logging methods are briefly discussed along with some of the problems arising in the interpretation of the log. Relative methods of quantitative interpretation are described, with a discussion of relative reference lines, and specific examples are given showing the application of these relative quantitative interpretation methods. To show the variation of the methods described, specimen wells penetrating formations widely divergent in point of geologic age were selected to demonstrate the application. A relative reference line is determined for the Neutron Curve and

MINERALOGY, METALLURGY AND CERAMICS

by comparison to known petrophysical data such as porosities from diamond cores, a direct quantitative relationship is developed. The application of this relative calibration curve to logs of unknown wells will permit a reasonably accurate determination of porosity in limestone and dolomite formations. Specific examples are given showing the application of these relative methods of interpretation to logs of the Smackover limestone in Louisiana, the Edwards limestone and dolomites of South Texas, and Permian dolomites of West Texas. (auth.)

1709 Electrochemical Potential and the Distribution of Polonium on the Electrodes. M. A. Coche, H. Faraggi, P. Avignon, and H. Haïssinsky. J. phys. radium 10, 312-18(1949) Nov. (in French).

The authors have measured the critical potential for the deposit of polonium on gold and silver cathodes in a solution 10^{-13} N. The displacement of the critical potential with respect to the potential in more concentrated solutions is in the the opposite direction from that predicted from the equation of Nernst. Photographic examination of the deposits shows that a portion of the deposited atoms penetrate slightly into the cathode, particularly in the case of the gold cathode. It is suggested that the "active centers" in the surface play an important role in these two phenomena. These results permit an explanation of the observations of Chang (Phys. Rev. 69, 60(1946)) on the existance of groups in the α-spectrum of polonium.

1710 The Formation of Alloys by Diffusion in Powder Metallurgy. Pol Duwez. Powder Met. Bull. 4, 144-56(1949) Oct.

The homogenization of compacts made of copper-nickel, copper-zinc, and copper-tin was studied by means of x-ray diffraction and by recording the thermal expansion curves during heating at a rate of 6°F/min. For the Cu-Ni compacts, the thermal expansion curve is similar to that of a pure metal during sintering. The Cu-Zn and Cu-Sn compacts exhibit abnormal expansions which are related to the presence of intermediate phases during the process of diffusion. (auth.)

1711 Process for Refining Ores or Concentrates of Ores Containing Iron and Titanium or Vanadium. Nils Herman Brundin (to Höganäs-Billesholms Aktiebolag, Höganäs, Sweden). Canadian Patent 462,240, Jan. 3, 1950.

The claimant has devised a process for reducing ores containing iron along with other metals more difficult to reduce. The reduction may be carried out at so low a temperature that the iron is completely reduced while the other metals, such as titanium and vanadium, are affected only slightly. The reduction product may then be melted and the slag may be separated from the pure iron. If the reduction is carried out at a higher temperature, both the vanadium and iron may be reduced. The slag, rich in titanium may then be separated from the mixture of reduced iron and vanadium.

1712 Some Physical Properties of Titanium. Herbert I. Fusfeld and Joseph T. Gilbert. Phys. Rev. 77, 302-3(1950) Jan. 15 (Letter to the editor).

MINERALOGY, METALLURGY AND CERAMICS

Tests were made to determine the internal resistance and velocity of sound in three titanium rods. The results are tabulated. The measured velocities ranged from 4960.0 to 4983.5 m/sec, the specific damping coefficients from 1.48×10^{-4} to 2.39×10^{-4} and the modulus of elasticity from 11.15×10^{11} to 11.24×10^{11} dynes/cm^2.

1713 Ultrasonic Measurements in Metallic Beryllium at Low Temperatures. W. C. Overton, Jr. J. Chem. Phys. 18, 113-15(1950) Jan.

Using the ultrasonic pulse method, the velocity of longitudinal waves in metallic beryllium has been measured from 300 to 23°K, and transverse waves from 300 to 3°K. The adiabatic moduli and compressibility have been computed from the velocities. A new technique for affixing the quartz transducer to the solid for ultrasonic measurements, in suitable solids, below 100°K, has been successfully employed for the measurements in beryllium. (auth.)

1714 On the Radioactivity of the Sand from the Beaches Along the River of Crach (Morbihan). René Coppens. Compt. rend. 229, 1319-23(1949) Dec. 14 (in French).

The sand of the beaches from Demoiselles to Pénestin is composed largely of heavy elements. A certain amount of radioactivity is, therefore, to be expected in these sands and, in fact, has already been detected (Compt. rend. 228, 1938 (1949)). The activity of the sand from various beaches was measured by photographic methods and the results are tabulated. This activity appears to be due, primarily, to thorium and to small inclusions of uranium. The distribution and possible origin of the radioactivity are discussed.

PHYSICS

1715 On the Secondary Particles of Local Penetrating Showers. O. Piccioni. AECU-694, June, 1949. 19p.

An analysis of the secondary particles of the local penetrating showers has been done by means of absorption experiments and delayed coincidence measurements. The large majority of those particles, filtered with about 12 in. of Pb appear to be mesons, which have been identified as π mesons. The average number of those mesons per shower is about 4. The analysis also gives a lower limit of 1200 g cm^{-2} for the mean free path for nuclear absorption of π mesons having energies of some hundred Mev. This result is discussed in connection with other experiments on local penetrating showers. (auth)

1716 Charged Particles of Low Energy Associated with the Ends of μ Meson Tracks. M. Blau, M. Block, H. Friedman, and J. Nafe. AECU-696, nd. 6p.

In scanning Ilford C_2 200-micron emulsions exposed for 3 hr in Minnesota at an altitude of 93,000 ft, 3 tracks of low energy particles with greater mass than a μ meson, each starting near the end of the track of a μ meson have been observed. In two cases the charge of the μ meson seems to be positive. In view of the theoretical significance these events may have, if verified, they are described in detail in this report.

PHYSICS

1717 Stars in Photographic Emulsions Initiated by π^--Mesons. Frank L. Adelman and Stanley B. Jones. UCRL-530, Nov. 29, 1949. 11p.

Stars initiated by π^--mesons in photographic emulsions have been examined in order to determine the probability that such a meson will form a star of a specified number of prongs. In making this study, those events were termed stars in which at least one track could be discerned leaving the terminus of the meson with a well-defined direction. A star was considered to have a recoil as one of its prongs when at least one of its branches was a "heavy" track less than 5 μ in length, with a definite direction. However, a poorly defined group of grains, showing no preferred direction, was not considered a prong, but was called a "club." Mesons that ended within 5 μ of either emulsion surface were discarded in order not in include stars all of whose prongs might not be observable. The observations are discussed.

1718 Altitude Curve of the Penetrating Component of Extensive Atmospheric Showers of Cosmic Rays. G. T. Zatsepin, I. L. Rozental, and S. A. Slavatinskiĭ. Doklady Akad. Nauk S.S.S.R. 69, 531-3(1949)(in Russian).

The part played by penetrating particles in extensive showers was investigated by counting coincidences, in a setup described in Zhur. Eksptl. i Teoret. Fiz. 18, 259(1948), at 3860 and 4700 m altitude and under Pb filters from 0 to 36 cm. It was found that there is no correlation between the absorption in Pb and the altitude effect, if the particles are assumed to be μ mesons. The analysis of possible causes of the strong altitude effect shows the very effective part played by nuclear collisions combined with the decay of secondary particles. This agrees with Zatsepin's views on the genesis and composition of extensive showers (Doklady Akad. Nauk S.S.S.R. 67, No. 6(1949)). A possible explanation is given of the discrepancy between the authors' findings and those of Cocconi et al (Phys. Rev. 75, 1063(1949)).

1719 Cosmic Radiation and the Maintenance of a Potential Gradient in the Atmosphere. S. A. Korff. Phys. Rev. 77, 144(1950) Jan. 1 (Letter to the editor).

It is known that a large potential difference exists between the ionosphere and the surface of the earth. Because of the finite conductivity of the atmosphere, this difference of potential must be maintained by the action of some outside agency. The author believes that cosmic rays contribute to the maintainance of this potential difference. He assumes that each primary proton is accompanied by an electron which, because of its lower energy, does not penetrate as far down as the proton. This leads to an accumulation of negative charge in the upper atmosphere. It is estimated, however, that the rate of accumulation cannot be high enough to counteract the effects of conduction in the atmosphere, and that some other mechanism must also be at work.

1720 Determination of the Charge Sign of Primary Particles of Cosmic Rays from Measurements of the Azimuthal Asymmetry in the Stratosphere Near the Equator. S. N. Vernov, N. L. Grigorov, N. A.

Dobrotin, S. P. Sokolov, F. D. Savin, and A. I. Kurakin. Doklady Akad. Nauk S.S.S.R. 68, 253-6 (1949)(in Russian).

Measurements by Johnson and Barry (Phys. Rev. 56, 219 (1939)) showed a 7% east-west effect of cosmic rays in the stratosphere, whereas this effect, as calculated by Johnson on the assumption of positively charged primary particles, should be 60%. According to Vernov and Kulikov (Doklady Akad. Nauk. S.S.S.R. 61, No. 6(1948)) the scattering of the secondaries is small, while Brikker et al (Doklady Akad. Nauk S.S.S.R. 57, No. 2(1947)) have found that there are not many electrons among the primary cosmic rays. Thus the question of the sign of the primaries' charge was not settled. The present authors measured the azimuthal asymmetry in the stratosphere at 6 to 10 deg. S. magnetic latitude. The instrument was a counter telescope with the axis at 60 deg. with the vertical; three photo-elements rigidly attached to the telescope caused a small motor to turn the telescope around the vertical until none of the photo-elements were illuminated by sun rays; this was the east-west position automatically corrected according to the azimuthal position of the sun by means of a clock movement; after a certain number of coincidence pulses, the telescope automatically turned 180 deg. around the vertical. As a result of the measurements, the coefficient $2(N_{west} - N_{east})/(N_{west} + N_{east})$ was found to be 45 to 50% for the asymmetry of the total cosmic-ray intensity in high altitudes, and 70% for the asymmetry of the penetrating component. This proved the positive charge of the primary radiation.

1721 Determination of the Density Spectrum of Extensive Atmospheric Showers with the Aid of an Ionization Chamber. M. I. Podgoretskiĭ. Doklady Akad. Nauk S.S.S.R. 67, 1005-8(1949)(in Russian).

On the average, a pulse produced by a shower in an ionization chamber is proportional to the shower's density. Therefore, an amplitude distribution of pulses will characterize a density distribution of showers. However, the existence of fluctuations does not permit an identification of the pulse spectrum with the density spectrum. It is clear that the difference between both spectra is smaller the higher the density of the showers. The purpose of this paper is a derivation of the quantitative aspects of this relationship. It is assumed that atmospheric showers consist of relativistic particles alone whose spatial distribution obeys Poisson's law. The results obtained can be applied directly to high pressure chambers in which the part played by strongly ionizing particles is small. The formulas give the mean pulse amplitude and the pulse dispersion as functions of the shower's density and of the shape and dimensions of the chamber.

1722 Generation of an Electron-Photon Component of High Energy. G. Ya. Artyukhov, G. T. Zatsepin, L. I. Sarycheva, and L. Kh. Eĭdus. Doklady Akad. Nauk S.S.S.R. 69, 153-6(1949)(in Russian).

Showers of high-energy electrons and photons were studied at 3860 m altitude with the aid of a hodoscopic instrument. The results confirmed the authors' former conclusion (Doklady Akad. Nauk S.S.S.R. 68, No. 3(1949)) that these high-energy components (2×10^9 - 3×10^9 ev) were generated at various depths in the air by fission-producing particles present in extensive atmospheric showers. In view of the analogy between this process and the formation of "special" showers under Pb, the authors extend that term to the phenomenon taking place in the atmosphere. High-energy electrons and photons are observed chiefly in extensive showers of moderate density.

1723 Investigation on the Structure of Showers Generated by Primary Cosmic Rays in the Stratosphere. S. N. Vernov and A. N. Charakhch'yan. Doklady Akad. Nauk S.S.S.R. 69, 523-5(1949)(in Russian).

A comparison was made between showers generated by stratospheric particles in Pb and in Al. At 27 km altitude, the ratio between average numbers of showers created in 8 to 10 cm Pb and in 10 cm Al was 5/2. In showers generated in Pb angular divergences exceeding 90 deg. are considerably more frequent than in those produced in Al. These findings attest to the formation, besides penetrating particles, of an electron-photon component multiplying cascade-like. Consequently, showers generated by primary rays are similar to the "special" showers observed on high mountains.

1724 Measurements of the Altitude Effect of Electron-Nuclear Showers. L. Kurnosova and N. Tikhonova. Doklady Akad. Nauk S.S.S.R. 69, 535-7(1949)(in Russian).

Countings of showers under Pb were made during flights at 6,500 to 10,000 m, with a view to establishing a link between observations, made at lower altitudes and in the stratosphere, on the nature of the component responsible for the generation of those showers. The relationship between the latter and the frequency of extensive atmospheric showers was also measured. In the instrument employed, showers of electromagnetic character were practically excluded, the bulk of observations dealing with showers generated by particles that produce nuclear disintegrations. These particles, producing in lead showers of electrons and nuclei, are absorbed in air exponentially, with $1/\mu = 90$ g/cm^2; however, a correction for angular distribution would probably increase this to $1/\mu = 100$ to 120 g/cm^2, in accordance with data for all altitudes up to 20 km. The observations confirmed also that one part at least of the particles in question belong to extensive atmospheric showers.

1725 Nuclear-Cascade Process and Its Part in the Development of Extensive Atmospheric Showers. G. T. Zatsepin. Doklady Akad. Nauk. S.S.S.R. 67, 993-6(1949)(in Russian).

In this note the author's views on the nature of extensive showers are exposed in a comprehensive manner. Unlike the electron-photon cascade theory, this new hypothesis lays stress on the presence in the showers of disintegration-producing, "nucleo-active," particles multiplying, cascade fashion, all through the air. They form the principal and, originally, the most energetic part of the development, while the electron-photon cascades, and the "penetrating component" (mesons), originate, as secondary products, during the collisions of nucleo-active particles with nuclei of the atmosphere. The function of the primary particles (protons and other nuclei) is to start the whole process by a first nuclear collision in the stratosphere. The main support of this theory is furnished by the frequency of "special" showers, so called by the group of workers studying them at

PHYSICS

the altitudes of the Pamir mountains (4,000-5,000 km); a "special" shower is produced in Pb by some high-energy nucleo-active particle.

1726 Nuclear Disintegrations as Detected with Electron-Sensitive Emulsions Exposed in the Stratosphere. J. J. Lord and Marcel Schein. Phys. Rev. 77, 19-25(1950) Jan. 1.

The nature of high energy nuclear interactions produced in photographic emulsions was investigated in the stratosphere. Examples are given, which were selected to show the principal modes of interactions, which lead to the emission of groups of particles with ionization energy losses corresponding to the minimum value for singly charged particles. For cases in which more than two particles of minimum ionization were emitted, the incident particle was found to be charged in nearly every case. The angular distribution of emitted minimum ionization tracks was measured as a function of the angle with the direction of the incident track. The zenith angle distribution of incident particles producing groups of minimum ionization tracks is given for two different altitudes in the stratosphere. (auth)

1727 Particles Capable of Producing Nuclear Disintegrations, as Observed in Extensive Atmospheric Showers. G. T. Zatsepin and L. I. Sarycheva. Doklady Akad. Nauk S.S.S.R. 69, 635-8(1949)(in Russian).

Opinions differ on the nature and genesis of penetrating particles recorded by instruments at the passage of extensive atmospheric showers. Some authors describe them as mesons from the air, for others they are high-energy photons generating mesons in Pb. In the present authors' view, extensive showers have a complex constitution, comprising, besides the electron-photon component, penetrating particles of two types: particles that do not produce nuclear disintegrations (probably mesons), and "nucleo-active" particles generating, through collisions with nuclei, all the other components of the extensive atmospheric showers. In the present note experiments, made at 3860 m altitude, are described, corroborating the above hypothesis. Effects were compared of the traversing of 22 cm Pb by "solitary" particles and by those accompanied by an extensive shower. Whereas the former, in 96.5% cases, do not produce showers under lead, the latter generally generate showers containing, besides electrons, new penetrating particles. The former are probably μ mesons, while the latter are the "nucleo-active" particles. According to a rough estimate, there are at least 20% nucleo-active particles among the total number of penetrating ones.

1728 Production of Gamma-Rays in Nuclear Interactions of Cosmic Rays. B. P. Gregory, B. Rossi, and J. H. Tinlot. Phys. Rev. 77, 299-300(1950) Jan. 15 (Letter to the editor).

This letter is based on a preliminary statistical analysis of 47 cloud-chamber pictures showing nuclear interactions in which electronic showers were produced. The cloud chamber contained 7 Pb plates (¼ in. thick) and 6 Al plates (5/16 in. thick) placed alternately, and was triggered by a counter telescope shielded with Pb placed underneath the chamber, in anticoincidence with a large double tray of counters placed above. One of the photographs is reproduced. It shows a nuclear event produced by a neutral particle in one of the Al plates. Four highly penetrating particles are produced in this event, and subsequently produce showers in other plates. The picture includes two examples of a nonionizing link between the center of a nuclear event and the starting point of a shower. Similar examples were found in other plates. The energies of several of the showers are calculated, and the origin of these showers is tentatively explained.

1729 Solar Cosmic Radiation on December 24 and 25, 1948. Alfred Ehmert. Z. Naturforsch. 4a, 559-60(1949) Oct. (Note, in German).

Attention is directed to the increase in cosmic radiation found by the author on December 24 and 25, 1948, and to the simultaneous occurence of sunspots and disturbances of the earth's magnetic field.

1730 A Study of the Altitude Curve of Showers Generated by Primary Cosmic Rays in the Atmosphere. S. N. Vernov and T. N. Charakhch'yan. Doklady Akad. Nauk S.S.S.R. 69, 629-30(1949)(in Russian).

Measurements are described of the altitude distribution in the stratosphere of penetrating particles that generate showers in lead. The instrument's geometry permitted the recording of showers composed of greatly diverging particles, thus increasing the efficiency of the instrument. A rapid increase of the number of showers with the altitude was observed and interpreted as a proof that the generating particles were the primary cosmic rays. It follows from the shape of the curve that up to ~20 km the absorption in the air is expressed by $1/\mu = 100$ g/cm^2, while beyond that altitude $1/\mu = 50$ g/cm^2. This change may point to the presence of a considerable number of α particles among the primary rays.

1731 Study of "Special Showers" of Cosmic Rays with a Hodoscope. L. N. Korablev, A. L. Lubimov, and A. T. Nevraev. Doklady Akad. Nauk S.S.S.R. 68, 273-6(1949)(in Russian).

Formation of "special showers" in thin layers of matter (3 mm Pb) was studied with the aid of a hodoscopic set-up comprising 176 counters in whose circuits electronic tubes were replaced by neon bulbs (see Korablev, Doklady Akad. Nauk S.S.S.R. 62, 215(1948)). By using thin Pb layers, the formation of appreciable electron-photon cascades was prevented; sets of telescope counters indicated the showers' density; and counters under Pb at the bottom of the setup revealed the presence of penetrating particles. It was found that the quantity of penetrating particles was larger, the higher the density of an individual shower; since the density of a "special shower" is determined chiefly by its electrons, it follows that, on an average, greater quantities of penetrating particles accompany electron-photon components of higher energy. The large quantity of hodoscopic counters in the instrument permitted the observation of the "structure" of some of the showers, e.g., of the presence of two trunks. The correlation, many times observed, between "special showers" and extensive atmospheric showers, was confirmed.

1732 A Low-Temperature Calorimetric Cryostat. G. D. Oliver, J. W. Grisard, and V. E. Anderson. K-550, Jan. 20, 1950. 14p.

PHYSICS

A low-temperature adiabatic cryostat for determining precise calorimetric data is described. The accuracy of the data produced by this apparatus has been established by measuring the thermal properties of n-hexane up to 300°K. These data agree with available precise data, in general, to within 0.2%. The precision of the heat capacity measurements is, for the most part, better than 0.1%. (auth)

1733 Logarithms in Instrumentation. W. G. James. ORNL-413, Sep. 26, 1949. 54p.

This is a survey of the applications of instruments whose outputs are proportional to the logarithm of their inputs and of the devices available for obtaining such response in instruments. Instruments developed and used at Oak Ridge National Laboratory are included as well as those described in the technical journals. The devices described have been used to measure logarithmically currents from 0.03 $\mu\mu$ amp to 10 ma and voltages from 1 mv to 10 v. The only practical limit in the preceding is the 0.03 $\mu\mu$ amp value. The large number of methods available for making currents or voltages proportional to other quantities permits a great number of measurements to be made with these logarithmic devices. 23 references. (auth)

1734 D-C Analog Solution of Simultaneous Linear Algebraic Equations: Circuit Stability Considerations. W. A. McCool. Naval Research Laboratory Report No. NRL-3533. Sept. 9, 1949, 10p.

A simple and novel technique has been developed for positively stabilizing the electronic computing circuit usually employed to solve a system of simultaneous linear algebraic equations. The stabilized circuit solves a corresponding system of differential equations, the steady-state solution of which is identical to the desired solution of the algebraic equations. Heretofore, elaborate transformation of the given system of equations, in the general case, has been required to insure a stable "mechanizing" circuit. When this new technique is applied, however, such a transformation is not required and there is no sacrifice of computing accuracy. The theory, explaining how stabilization is effected and how the general stability criteria for such computing circuits are satisfied, has been developed in some detail. As a practical example the solution of a system of five equations has been obtained by applying the stabilizing technique in several different ways. (auth)

1735 Digital Computer Research at Birkbeck College. S. C. Lowell. Office of Naval Research, London Branch, Technical Report No. OANAR-50-49, Dec. 12, 1949. 5p.

Dr. A. D. Booth of Birkbeck College, University of London, is building three digital computers: the automatic relay computer (ARC), the simple electronic computer (SEC), and the all purpose electronic x-ray computer (APEXC). The design features and operating characteristics of these calculating machines are described in this report. (auth)

1736 Digital Computers as Information-Processing Systems. Jay W. Forrester. M.I.T. Servomechanisms Laboratory Report No. R-166, June 1, 1949. 30p. (NP-1171).

PHYSICS

This discussion is presented in four parts as follows: (1) illustrations of information-processing systems; (2) a general description of a digital computer; (3) a few elementary principles of computer operation; (4) the coding or instructing of an automatic computer in a few simple processes.

1737 The Edsac Computing Machine, Cambridge University. S. C. Lowell. Office of Naval Research, London Branch, Technical Report No. OANAR-43-49, Nov. 25, 1949. 8p.

The EDSAC (electronic delay storage automatic computer) is a high speed, serial, digital computer working in the binary scale, and is being used as a general purpose calculating machine for the solution of complicated and arduous problems in mathematics and mathematical physics. This report describes the design features and present use of the EDSAC.

1738 Pulse Modulation Research (Seventh Quarterly Progress Report). P. F. Ordung and H. L. Krauss. Yale University Dunham Laboratory, Feb. 21, 1949. 9p. (NP-1088.)

The principal progress to be reported in this quarter is in the development of auxiliary apparatus to be used in connection with the Megasweep for viewing the frequency response of amplifiers, networks, etc., over wide frequency bands. A useful instrument hereafter referred to as the "Visuator" has been developed. The visuator consists basically of an electronic switch that permits the output, including the d-c component, of two crystal detectors to be displayed simultaneously on the screen of a single oscilloscope. A block diagram of the instrument, showing the basic elements, is included.

1739 A Sensitive Magnetometer for Very Small Areas. Daryl M. Chapin. Rev. Sci. Instruments 20, 945-6 (1949) Dec.

A vibrating wire system for measuring weak magnetic fields is described for use in very small spaces. Quartz crystals are used for drivers to get sufficient velocity with very small displacements. In order to adjust the driving voltage to correspond exactly to the natural crystal frequency, the crystal is also used to regulate the oscillator. (auth)

1740 A Slide Rule for Radiation Calculations. M. W. Makowski. Rev. Sci. Instruments 20, 876-84 (1949) Dec.

A slide rule has been developed to facilitate rapid calculations based on the Planck radiation formula. Quantities such as the radiant flux density in a given wavelength region, the spectral radiant flux density at a given wavelength, or the corresponding quantities expressed in photon units, can be obtained readily for a black body over a range $\lambda T = 2 \times 10^2$ to $\lambda T = 4 \times 10^6 \mu$ degrees with an accuracy of about 1%. Simple extension rules can be used for larger values of λT. (auth)

1741 A Trouble-Location Scheme for a Digital Electronic Computer. George G. Hoberg and Edwin I. Blumen-

PHYSICS

thal. M.I.T. Servomechanism Laboratory Report No. R-163, Apr. 21, 1949. 121p. (NP-1179.)

Large-scale digital electronic computers are at present being developed at a number of laboratories throughout the country. Their ability to reduce large masses of information into concise and intelligible form, and to solve complex mathematical problems very quickly, will permit accomplishments in the fields of science and industrial and military control which have hitherto been beyond the realm of possibility. Perhaps the greatest threat to the expected phenomenal success of these computing machines is the fact that they contain myriad electronic components which are, by their nature, subject to failure. The laws of probability state that these failures will occur, and one failure anywhere in a huge machine can completely disrupt its operation. The only course is to strive to minimize the frequency of occurrence of failures and to provide a rapid means of finding them when they do occur. One of a number of possible methods for checking machine operation and improving reliability is the use of test problems which, if solved incorrectly, will indicate that some part of the computer is not functioning properly. In fact, since the nature of an error is some criterion of the type and location of the fault causing the error, test problems can be devised to provide information from which the specific location of a fault can be deduced. In this thesis the method of trouble location by means of test problems is applied to a particular digital computing element, the Project Whirlwind five-digit Multiplier. A discussion of the general aspects of the method and its limitations is followed by the functional design of a system for automatic utilization of test problems in the multiplier. An optimum test-problem sequence is then derived after a detailed study of the performance of Multiplier electronic circuits when various possible faults exist. (auth)

1742 Refrigeration System Used in Mercury Isotope Collections. F. R. Duncan and W. G. Cobb. Y-538, Dec. 19, 1949. 17p.

This report covers the design, development, and operation of a refrigeration system used in the electromagnetic separation of mercury isotopes. Descriptions of the physical installation, control circuit, safety requirements, and operational technique and characteristics are included. (auth)

1743 On Increased Concentrations of Artificially-Radioactive Elements. A. S. Karamyan and G. E. Kogan. Doklady Akad. Nauk S.S.S.R. 68, 477-9(1949)(in Russian).

Studying the separation of radioactive Br isotopes by irradiating C_2H_5Br with slow neutrons, the author has shown (Doklady Akad. Nauk S.S.S.R. 64, 491(1949)) that, together with the liberation of Br atoms through recoil action, the reverse process takes place, viz. the recombination into organic molecules. The question examined here is whether the rate of the recombination depends on the nature of the compound used. The experiment was made with equal volumes of C_2H_5Br, $C_2H_4Br_2$, and $CHBr_3$. If the recombination rate was the same in the three cases, the ratios of the activities of samples of radioactive Br obtained should be 1:1.75:2.56, equal to the ratios between the numbers of Br atoms in equal volumes of the three compounds. The measurements showed that in the case of C_2H_5Br the activity obtained was many times greater than in the other two cases. On the other hand, the total activities of irradiated substances, measured before the subsequent separation of the free bromine, stood to each other in the above ratios.

PHYSICS

1744 On a Physical Method of Separation of Nuclear Isomers. A. S. Karamyan. Doklady Akad. Nauk. S.S.S.R. 68, 269-71(1949)(in Russian). (See also NSA 3-1937 and 4-229.)

In Doklady Akad. Nauk. S.S.S.R. 64, No. 4(1949) the author has described the mechanism of the separation of Br^{80} and Br^{80*} by irradiating C_2H_5Br with slow neutrons and precipitating electrically (upon Ag) bromine atoms that have not recombined into organic molecules after having been set free by recoil action. Two successive recoil liberations, separated by a recombination, take place, viz., setting free of Br^{80*} during irradiation, and liberation of Br^{80}; the intermediate recombination follows an exponential law. In the present work the question was investigated whether, at the first stage, all Br^{80*} atoms are expelled from the molecules, or only a part of them. The method used was an irradiation of a mixture of 60 cm^3 C_2H_5Br with 300 cm^3 $(C_2H_5)_4Pb$, the latter molecules hampering the recombination of the former. The comparison of the results with those obtained when no $(C_2H_5)_4Pb$ was used showed that, whereas the numbers of free Br^{82} (34 hr) and Br^{80*} (4.4 hr) were equal in both cases, the number of free Br^{80} (18 min) was five times larger in the absence of the lead compound. Since the precipitation took place 3.5 hr after the irradiation, it follows that all Br^{80} observed were of secondary origin. The results show that during the irradiation all the radioactive atoms formed are expelled from the molecules. The rate of the following recombination is considerably higher during the irradiation than after it.

1745 A New Type High Intensity Mass Spectrometer and Its Application to the Separation of Boron Isotopes. Hoff Lu. Summaries of Ph.D. Theses Univ. Minnesota 4, 186-8(1949).

A high intensity mass spectrometer, capable of producing ion currents of one μamp, was used to separate the boron isotopes. Ions were extracted from an electrical discharge in BF at low pressure. Three different ion sources were used simultaneously, the three beams diverging into a magnetic field designed to focus such a beam arrangement. Targets have been produced containing 7 μg of B^{11} in about 300 atomic layers, and 1.5 μg of B^{10} in about 80 layers, and tests using already established nuclear reactions have been carried out to substantiate the separation.

1746 Applications of the Elliptic Functions in Physics and Technology. Fritz Oberhettinger and Wilhelm Magnus. Berlin, Goettingen, Heidelberg, Springer, 1949 (in German) 126p.

This book briefly lists results from the theory of elliptic functions (without proof) and provides numerous examples of their applications. Elliptic integrals, theta functions, Jacobi's elliptic functions, Jacobi's zeta function and the Weierstrass zeta function are dealt with in detail. A discussion is also given of conformal mapping and greens functions.

PHYSICS

1747 Some Properties of the Parallel Plate Spark Counter II. Leon Madansky and R. W. Pidd. AECU-675, Sept. 21, 1949. 12p.

The delay error distribution of the parallel plate spark counter (Phys. Rev. 75, 1175(1949)) has been measured and the average delay is found to be 6×10^{-9} sec. The counters are, therefore, applicable to the measurement of lifetimes as short as 10^{-9} sec. Auxiliary circuits, including a fast synchroscope, for short time interval measurements are described, and the resolution limitations of the counters and circuits are discussed. (auth)

1748 Scintillation Type Ion Detector. Paul I. Richards and E. E. Hays. AECU-678, Sept. 19, 1949. 6p.

A sensitive detector is described for use with a time-of-flight mass spectrometer to indicate the time of arrival of low energy ions. The following principle is involved: when the ions reach the detector, they are accelerated to relatively high energy and projected upon a luminescent material; the resulting photons are then piped along a quartz rod out of the vacuum system and away from the magnetic field, where they in turn may be detected by a conventional photomultiplier tube and amplifier. Three phosphors were studied: silver-activated zinc sulfide, thallium-activated sodium iodide, and anthracene. Of the 3 materials investigated, ZnS:Ag is the most conveniently used. It is unaffected either by humidity or vacuum, and the powder will adhere to the end of the quartz rod after the latter has merely been rubbed in the hand. The principal disadvantage is the long decay time of about 25 μsec, which tends to mask small ion bunches following closely on larger ones. NaI:Tl has a much shorter recovery time than ZnS:Ag and, like the latter, will withstand the vacuum indefinitely. A convenient way of placing the phosphor on the quartz rod consists of heating the latter well above 100°C and painting the solution on it. The great disadvantage of NaI:Tl for ion detection, however, is its extreme deliquescence, which requires that it be placed in the vacuum system while still hot and renewed each time the system is opened. Anthracene, of the 3 materials investigated, probably has the best combination of properties for our particular application. The recovery time is very short, and there is little evidence of a long-period component. The crystals were attached to the end of the quartz rod by imbedding them in a thin layer of Dow-Corning silicone stop-cock grease.

1749 Gas Phase Counting of Low Energy Beta Emitters. W. Bernstein and R. Ballentine. AECU-680, nd. 19p.

A proportional counter has been designed to detect soft β-emitters in the gas phase. Data is presented to illustrate the applicability of the counters to the detection of C^{14}, S^{35}, and H^3. Various partial pressures of $C^{14}O_2$ have been investigated to determine the effects on the counter properties. Corrections have been made for the counter ends, and the memory effects are described. An energy spectrum is presented for H^3 to determine the low energy limit of the instrument. (auth)

1750 Desirable Improvements in Nucleonics Instrumentation. J. B. H. Kuper. AECU-682, nd. 18p.

Many of the difficulties that plagued nuclear instruments in the years immediately following the war have been overcome, and the commercially available products are now

PHYSICS

generally far better engineered, but the quality of the components used is still not too good. In certain items, particularly scalers and power supplies for Geiger-Mueller counters and portable Geiger-Mueller counter survey meters, there are many competitive sources of supply; but other more specialized equipment is not yet commercially available. In the field of personal monitoring equipment, the chief needs are for better means of measuring neutron exposures (fast and slow) and ionization chambers which will respond to various types and energies of radiation more nearly as the human body does. In the case of portable survey instruments it is thought that the portable Geiger-Mueller counter instruments should be used primarily for roughly locating areas to be studied and that the ionization chamber instruments be used for quantitative work. The latter suffer somewhat from lack of a window material for use with α particles which will be sufficiently strong and moisture resistant, and give trouble with short battery life. Sealed chambers for γ and hard β rays give relatively little trouble, but portable instruments for neutron work are not yet available in satisfactory form. It is thought that the importance of the Geiger-Mueller counter in research work is diminishing and that proportional and scintillation counters will be of greater interest. To take full advantage of the selectivity of these counters, better high voltage supplies and fast amplifiers combining exceptional gain stability with unusual freedom from overload effects are needed. Also, pulse height analyzers (kicksorters) of both the multichannel and single channel types are needed. These might be of the conventional type or, perhaps special beam deflection tubes. In addition faster scalers are needed. With respect to the tendency to add "gadgets" to commercial counting equipment, it is considered that decade scalers are usually more trouble than they are worth, since they seem inevitably to require more servicing and the extra convenience in interpolation is seldom really useful. Counting rate meters are useful primarily where it is desired to record a varying activity level over long periods, or in portable equipment. They are not particularly good for making quick rough measurements. Whether a predetermined time or predetermined count method of counting should be used depends primarily on the amount of further computation needed in a particular experiment. In many cases the convenience of the constant statistical error in the predetermined count is outweighed by the necessity of taking reciprocals when subtracting the background. (auth)

1751 A Laboratory Alpha Scintillation Counter. W. Bernstein, E. H. Foster, and D. G. Clareus. AECU-686, nd. 5p.

A stable, low background α counter for routine laboratory use is described. It is of scintillation type, utilizing a ZnS-Ag phosphor, which is deposited on the photosensitive face of a photomultiplier tube. The counter operates directly a conventional Geiger tube scaler. The efficiency of the counter for a $\frac{3}{8}$ in. diameter source placed at the top of the sample hole is 45%.

1752 Evaporating Jig for Geiger-Mueller Tubes. William Liben. AECU-692, nd. 2p.

A detailed drawing is shown of a jig for use with a small bell jar vacuum system to evaporate metallic electrodes on

the inside of 19 mm glass tubes for construction of G-M tubes. The operation of the jig is explained.

1753 Preparation of a Parallel Plate Spark Counter. R. W. Pidd and L. Madansky. AECU-697, nd. 9p.

An electrode preparation technique has been developed for parallel plate spark counters which can be operated at 1000 volts overvoltage with a recovery time of 1 msec. The efficiency for electron detection is 98%. The electrodes are 0.003 in. copper foil cleaned both chemically and then by running glow discharges in oxygen and hydrogen. The problem of obtaining short recovery times in spark counters is discussed. (auth)

1754 Detection of Tracks and Stars in Nuclear Track Plates. E. H. Land, G. Bird, and W. A. Shurcliff. AECU-700, nd. 9p.

Tracks and stars in nuclear track plates are usually found by ordinary bright-field microscope procedures affording limited field of view and requiring continual focusing up and down. Standard dark-field illumination schemes fail due to background scattering by fog grains. A rotating-azimuth, planar, dark-field, illumination scheme has been developed which provides sufficient contrast so that low magnification (50 to 100 times) may be used. The field of view is thereby increased to 2 to 4 mm, and the depth of field becomes comparable to the total thickness of the emulsion. (auth)

1755 Austin Beta-Gamma Hand and Foot Checker; Test Reports. J. G. Roback and W. E. Doniger. Austin Company. M-4463, Oct. 14, 1949. 9p.

Copies of final tests of stability and count accuracy are included. These tests were conducted with the hand and foot checker plugged into an unregulated a-c line on which electric drills and other similar equipment were connected and operating. The grounding wire was attached to an electric conduit. No adjustments were made other than placing the radioactive test sample so that all channels would count in the same order of magnitude. The test sample used was a small piece of uranium, secured by scotch tape to an aluminum plate.

1756 Bibliography Radiation Detection, 1st ed. USAEC Radiation Instruments Branch Report No. RIB-2, July 1949. 143p.

This bibliography of reports and journal references covers the following subjects: detector components, count rate meters, ionization chamber rate or integrating meters, scalers, accessories for radiation detection instruments, related instruments, radiochemical laboratory techniques, radiation interaction with matter, health physics, and radiation sources.

1757 An Air Ionization Chamber for Soft X-rays. Herman E. Seemann. Rev. Sci. Instruments 20, 903-7(1949) Dec.

An ionization chamber is described which is nearly air-equivalent from 0.5 to 2.5A, "effective wavelength". It has been made adaptable for use with the electrometer and charging system of the Victoreen Minometer. Its sensitivity is of the order of 0.15 r/scale division. Suggestions are made for possible improvements. (auth)

1758 Applications of the Photographic Plate Method for Detecting Nuclear Particles. Derek Leonard Livesey. p. 123-124. Abstracts of Dissertations Approved for the Ph. D., M. Sc., and M. Litt. Degrees in the University of Cambridge. 1947-1948. Cambridge, University Press, 1949.

An account is given of a series of experiments involving the application of photographic plates, as a means of recording the tracks of charged particles, to various problems in nuclear physics. The dissertation is divided into four sections, which are interrelated. The first section is a description of an investigation of the neutrons emitted in the disintegration of deuterons by deuterons. Measurements of the energy and the flux of the neutrons that are produced were carried out, and the energy release of the reaction was accurately determined. The angular distribution of the neutron flux that is emitted in this reaction is discussed in some detail. The second section consists of an account of the improvements in the photographic plate technique that are made possible by the production of concentrated emulsions by Ilford Ltd. The improved plates were employed in an investigation of the neutrons emitted in the disintegration of nitrogen by deuterons. This is described in the third section, which also includes a discussion of the accuracy of comparative flux measurements, with special reference to the determination of the angular distribution of the yield of neutrons that are emitted in nuclear reactions. Finally, photographic plates were used to record the tracks of fission fragments derived from uranium. The fourth section describes the investigation of a rare mode of fission in which a light nucleus is emitted in addition to the two heavy fragments. The experimental data are summarized and a brief discussion of the phenomenon is appended. (auth)

1759 Automatic Stabilization of the Overvoltage on a Geiger Counter. H. R. Crane. Rev. Sci. Instruments 20, 955-6(1949) Dec. (Laboratory and shop note).

The plateau region of a Geiger counter may shift or change in length during an extended period of observation. Such a shift would result in a change in the value of the overvoltage, and consequently, in a change in the amplitude of the output pulses. The pulse height may be used to stabilize the value of the overvoltage by means of a thyratron, which fires and lowers the high voltage when the pulse height exceeds a critical value. The high voltage then recovers through a condenser network, and in ordinary operation, the cycle is repeated every 5 sec. Several applications of such a circuit are described.

1760 Calorimetric Radioactivity Measurements. Orlo E. Myers. Nucleonics 5, 37-47(1949) Nov.

Microcalorimetric methods are reviewed which lend themselves to the exact determination of large sample radioactivity. Various instruments and the techniques of their use are discussed, among them differential and twin microcalorimeters, ice microcalorimeters, adiabatic microcalorimeters and isothermal microcalorimeters. Extensive bibliography (77 items).

1761 Circuit for Rapid Determination of Resolving Power and Other Characteristics of Coincidence Systems.

PHYSICS

H. de Waard. Rev. Sci. Instruments 20, 911-15(1949) Dec.

A simple device is described in which pairs of pulses are produced that are moved continuously with respect to each other (wobbled) by an a-c voltage that also sweeps an oscilloscope spot horizontally. The pulses are applied to both inputs of a coincidence system. Vertical deflection of the c.r. scope spot is caused by the output pulses of the system. Thus various characteristics can be made visible and the resolution can be read from the scope screen at a glance. With the instrument, resolving powers from 3.10^{-6} to 10^{-9} sec approximately can be determined. The apparatus was calibrated by feeding the wobbling pulses into a radio receiver. The output of the receiver has a sharp minimum when the pulse distance (Δt) satisfies the condition $\Delta t = (1 + 2n)/2\nu$ where n is an integer, ν is the frequency to which the receiver is tuned. (auth)

1762 Dead Times of Self-Quenching Counters. B. Collinge. Proc. Phys. Soc. (London) 63 B, Pt. 1, 15-24(1950) Jan. (See also NSA 2-558.)

Experiments on Geiger counters are described in which localization of the ion sheath was brought about by reducing the wire potential immediately after each count. The effect on the dead time is discussed. The dead time of a counter 30 cm long was found to be 20 μsec and independent of the counting rate up to 1.8×10^6 counts/min. The reduction of the dead time of short counters was also investigated. (auth)

1763 Double Magnetic Lens Nuclear Spectrometer. Harold M. Agnew and Herbert L. Anderson. Rev. Sci. Instruments 20, 869-76(1949) Dec.

A large double magnetic lens spectrometer has been constructed for the study of γ- and β-ray spectra. The magnetic field is produced by two identical coaxial water-cooled coils, each 10.2 cm wide, 31.7 cm ID, 73.7 cm OD and spaced 95.6 cm apart. The source is placed on the axis at the center of one coil and the detector is placed on the axis at the center of the other. The instrument is characterized by a large transmission with moderate resolution. Scattering is virtually absent because of the nature of the trajectories which are used, and because the large dimensions have made possible the removal of scattering material to a considerable distance from the source. The design has lent itself easily to the application of accelerating voltages at the detector admitting the detection of β rays down to 1 kv. The maximum energy conveniently studied with the present arrangement is 2.8 Mev. Beryllium-coated Zapon films of thickness 0.01 mg/cm^2 have been used to mount sources. Charge does not accumulate on these sources. Observations with a Cs^{137} source 4 mm in diameter have shown a transmission of 1.4% with a resolution of 1%. The appearance of the internal conversion and Auger electron lines testifies to the absence of appreciable scattering. (auth)

1764 Design Curves for 180° Magnetic Spectrometers. George E. Owen. Rev. Sci. Instruments 20, 916-23(1949) Dec.

The image shapes resulting from 180 deg. focusing of charged particles in a homogeneous magnetic field have been computed. General curves are presented in terms of three variables for variable ρ spectrometers (as in the case of photographic detection) and in terms of four variables for constant ρ spectrometers (as in the case of detection with a fixed counter). The variables are source and exit-slit height, source width, angular selection, and exit-slit width. The advantages of using sources and exit-slits with a large dimension parallel to the magnetic field (i.e., height) are noted. (auth)

1765 A Fractional Microsecond X-ray Pulse Generator for Studying High Explosive Phenomena. H. I. Breidenbach, Jr. Rev. Sci. Instruments 20, 899-903(1949) Dec.

An x-ray pulse generator capable of producing short bursts of x-rays not greater than 3×10^{-7} sec in duration has been constructed. These short bursts are obtained by supplying a negative 50-kv, 12.5 Joule trigger pulse to the cathode shield of a standard Westinghouse W.L. 389 flash x-ray tube. This pulse generates a pre-discharge plasma in the tube which blocks the main 100-kv, 290 Joule pulse until the cathode to anode gap impedance is lowered by ionization. An arrangement is also described whereby three separate, successive radiographs of a single detonation may be taken at predetermined time intervals. (auth)

1766 The Gamma-Ray Counting Efficiency for a Lead-Cathode G-M Counter. E. T. Jurney and Fred Maienschein. Rev. Sci. Instruments 20, 932-4 (1949) Dec.

The dependence of γ-ray counting efficiency on energy has been determined in the range 0.17 Mev to 2.76 Mev for a G-M counter with a lead cathode. The efficiency for six energy values was found by coincidence measurements utilizing the disintegration of In^{111}, Au^{198}, Co^{60}, and Na^{24}. The result indicates a smooth increase in counting efficiency for increasing energy over the range of energies investigated. (auth)

1767 Measurement of the Partial β Spectrum of ThB by the Method of Coincidences in a Double β Spectrometer. L. V. Groshev and L. Ya. Shavtvalov. Doklady Akad. Nauk S.S.S.R. 68, 257-60(1949)(in Russian).

A procedure is shown for the analysis of a complex β spectrum from a transformation in which the resulting nuclei occupy several excited levels. The usual β-γ coincidence method, convenient for the case of only one excited state, being inapplicable here, the authors employed β-β coincidences between a certain internal conversion and the corresponding β decay. The instrument consisted of a 2 m long metal pipe with a counter at each end; the radioactive source occupied the middle of the pipe, and the two opposite electron beams were focussed upon the counters by means of two magnetic lenses. One counter, through a fixed adjustment of its lens, received the conversion electrons, while into the other, by varying its len's field, decay electrons of different parts of the spectrum were directed. A frequency curve of the coincidences was thus obtained and was then converted into a Fermi curve of the level investigated. The method was used for the determination of the partial β spectrum of the transformation ThB – ThC which corresponds to a transition onto the excited level 238 kev; the γ quanta emitted are intensely converted. The source employed was a precipitate of Th(B + C + C″). The Fermi graph obtained is a straight line intersecting the energy axis at 340 kev.

PHYSICS

1768 Note on the Measurements of α-Particle Energies with Scintillation Counters. Bo Aler and Tor Wiedling. Arkiv Fysik 1, 335-8(1949).

A study was made of the distribution of pulse heights produced by α particles impinging on a Philips Metalix screen and on a thin crystal of naphthalene. These screens were employed in conjunction with a commercial RCA photomultiplier. A monoenergetic α source was first used to give some indication of the distribution of pulse height produced by instrumental factors alone. Alpha particles of different energies were obtained by slowing Po alphas in air, and distribution curves are given for the amplitudes of these pulses as a function of the energies of the alphas producing them. It is concluded that such distribution curves may be used to distinguish between α particles of appreciably different energies.

1769 On the Shape of the Pulse in an Ionization Chamber. A. I. Petrukhin, M. I. Podgoretskiĭ, N. D. Fedorov, L. N. Shtarkov, and M. N. Shcherbakova. Doklady Akad. Nauk S.S.S.R. 69, 539-41(1949)(in Russian).

Several authors have recently shown that a study of the shape of the ionization-chamber pulses offered valuable information on the nature of ionizing agents. To obviate the difficulties due to the complexity of the phenomenon, some workers (Bridge et al, Phys. Rev. 74, 1083(1948)) by using appropriate amplifiers, isolated, in a discharge through an inert gas, that part of the pulse which is produced by the electrons only. The present authors chose a different way: their amplifier recorded both low and high frequencies, and the resulting oscillogram presented a vertical part corresponding to the collection of electrons which was followed by a gently rising curve due to the movement of the positive ions. The shape of this latter curve reflects the various conditions of the ionization: thus, in a cylindrical chamber with the positive outer electrode, a curve convex toward the zero line indicates a "local" ionization near that electrode, while a concave curve denotes a uniform "volume" ionization caused by a shower of relativistic particles, and a curve with a kink is produced by a single strongly ionizing particle passing the inner electrode. Advantage can also be taken of the possibility of measuring separately the amplitudes Q_+ and Q_-, and of determining $Q_+ + Q_-$ and Q_+/Q_-.

1770 The Photographic Plate Technique and its Application to Cosmic Ray Studies. F. D. Manchester. New Zealand Sci. Rev. 7, 138-43(1949) Aug.

This article outlines the improvements in photographic plates and development techniques which made possible the use of plates in nuclear physics. The author explains how range-energy plots and plots of residual range against grain density may be used to determine the energy and mass of particles producing tracks, and describes the microscopes and scanning methods used in studying plates. After a discussion of the relative merits of the photographic method photomicrographs of several events are reproduced, and the type of information obtained from these plates is described.

1771 A Portable Roentgenmeter for Field Use. C. C. Lauritsen. Rev. Sci. Instruments 20, 964(1949) Dec. (Laboratory and shop note).

A portable roentgenmeter similar in size and shape to a fountain pen was first described at the December meeting of the Physical Society in 1932 (Lauritsen, Phys. Rev. 43, 212(1933)). This device is operated by a small battery. Under some conditions, replacement batteries may not be readily available. In such an eventuality a frictional charging device may be used to charge the electroscope contained in the instrument. A portable roentgenmeter with an incorporated frictional charge has been designed by the author.

1772 Precise Spatial Reconstruction of Phenomena Observed in Photographic Plates for Nuclear Research. Precise Determination of the Multiplicative Factor for the Vertical Projection of Tracks. L. Vigneron. J. phys. radium 10, 305-12(1949) Nov. (in French).

The shrinkage of nuclear emulsions at the time of development may be characterized by either of two factors: k or k', k being the ratio between the original and final thickness of the emulsion, and k' a factor which includes calibration inaccuracies in the microscope as well as the effect of shrinkage. The factor k' may be used directly to convert the measured value of vertical lengths to the correct value before shrinkage. The author has determined these factors empirically and theoretically and has found that his results for Ilford plates differ from those listed by the manufacturer. He has also determined the degree of accuracy possible in the spatial reconstruction of nuclear particle tracks.

1773 A Proportional Hodoscope. L. N. Korablev. Doklady Akad. Nauk S.S.S.R. 69, 643-6(1949)(in Russian).

The author's works on some nonstationary processes in electric discharges in gases (Doklady Akad. Nauk S.S.S.R. 26, No. 2(1948)) led him to the use of glow-discharge tubes in circuits of proportional counters and ionization chambers. The functions both of selecting pulses with amplitudes exceeding a certain "threshold," and of selecting coincidences of these pulses with the "master pulse that initiates a shower," are performed by only one glow-discharge tube, unlike the usual setups involving many electronic tubes. By using, in one channel, several neon tubes of various sensitivity thresholds, pulses are distributed in groups covering the whole amplitude spectrum. The simplicity of such a construction permits its being employed in hodoscopes comprising many proportional counters or ionization chambers.

1774 Pulse-Height Limiting Circuit for a Scintillation Detector. W. C. Elmore. Rev. Sci. Instruments 20, 963-4(1949) Dec. (Laboratory and shop note).

The output pulses from a photomultiplier, used in conjunction with a scintillation detector, may vary widely in amplitude. If the gain of an amplifier is set high enough so that it may detect the weakest pulses it will be blocked by the stronger pulses. In order to avoid this difficulty, the pulse height may be cut down by a limiter circuit placed before the amplifier. The author has designed such a circuit, in which the pulse height is limited to about 0.1 v by a network including three IN34 crystal diodes. The operation of the circuit is described as a function of the values of the various circuit parameters.

1775 Radioactivity Surveying and Monitoring Apparatus. Denis Taylor. Atomics 1, 5-9(1950) Jan.

Radiation monitoring apparatus may be divided into three classes: personal monitors, area monitors, and survey instruments. Under the first heading the author discusses film badges and pocket ionization chambers. Area monitors

are usually ionization chambers with amplifiers. These are mentioned briefly. The survey instruments discussed by the author are larger and more accurate ionization chambers which may be used to check the distribution of radioactivity in a laboratory. These instruments must be supplemented by sensitive monitors, usually Geiger counters, to indicate small amounts of local radioactive contamination.

1776 Rapid Response Radiation Alarm. R. L. Macklin and E. R. Rohrer. Rev. Sci. Instruments 20, 965-6 (1949) Dec. (Laboratory and shop note).

The radiation alarm described in this note has been designed to give a signal within 0.5 sec after the radiation intensity has reached a predetermined level. The device employs an anthracene crystal in conjunction with a photomultiplier. Signals from the photomultiplier are fed into a rate meter tank circuit, and the smoothed signal then goes to a thyratron grid. Tests show this circuit to be much faster than conventional circuits using ionization chambers.

1777 The Scintillation Counter. II. The Preparation of Transparent Inorganic Phosphor Screens. Lawrence B. Robinson, Charlie S. Cook, and Donald E. Jefferson. J. Chem. Phys. 18, 148-9(1950) Jan. (Letter to the editor). (See also NSA 3-1598.)

The authors have attempted to prepare phosphor screens having the desirable characteristics of both organic and inorganic phosphors without the undesirable characteristics of either. These screens were then used to count α particles with a scintillation counter. The screens were made by dispersing suitable inorganic phosphor powders in a transparent plastic. Plots are given for the counting rate as a function of the phosphor concentration for four different types of screens, and a relation which fits these curves is given.

1778 A Secondary-Emission Electron Multiplier Tube for the Detection of High Energy Particles. Robert P. Stone. Rev. Sci. Instruments 20, 935-41(1949) Dec.

The requirements of high gain and low background current in an electron-multiplier tube for the direct detection of high energy particles are considered. The design and construction of an experimental electronmultiplier tube with a stable over-all gain of at least 10^8 and a background at room temperature corresponding to three or four electrons/min released at the input is described. An 0.0008-in. thick nickel window is provided in the tube envelope to admit the high energy particles to the multiplier. The efficiency of this device is compared quantitatively with that of a Geiger tube as a detector of β particles. It is found that the over-all β-particle counting efficiency of the tube is of the order of 1.3%, and that the efficiency of the oxidized silver magnesium target surface is 4.9% for a uranium source and 6.0% for a strontium source. (auth)

1779 General Aspects of Meteorology in the Air Pollution Problem. Norman R. Beers. AECU-684, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Progress in stack meteorology, a branch of meteorological engineering, has been made by clearly demonstrating that the earth's atmosphere is not an infinite sink into which man may pour an unlimited quantity of pollutant. With a given array of

sources and effluent rates, the pollutant that may be disposed of [by discharging it] into the atmosphere depends on the weather and on the amount of pollution that is "tolerable" or otherwise permitted, not merely in the immediate vicinity of the source but sometimes for distances of many miles. Outstanding weather examples are briefly discussed. Meteorological control, as established by Hewson at Trail, B.C., and Beers and co-workers at Brookhaven, illustrates the possibilities in this new field. Stress is laid on the fact that in application specific studies are required for individual sites and polluting sources, and that the meteorological engineer must supply in advance the best possible information of the effect of weather on the operation or activity at hand. This requirement means that meteorological engineers must be proficient not only in the accepted field of "pure meteorology"; but must also become proficient in the operating practices of his client, and capable of interpretation and explanation as needed for an effective and efficient operation. A vast new field is opening with the present necessity to obtain a clean atmosphere.

1780 Micro-Climatic Factors in Smoke Pollution from Tall Stacks. Phillip H. Lowry. AECU-688, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The basic meteorological factors which affect the dispersion of effluent from tall stacks are discussed in terms of their utility in determining a pollution climatology. These factors include: wind speed, direction, and gustiness, and the vertical temperature gradient. It is shown that, for tall stacks, all of these factors can be approximated from the record of a single anemometer and vane mounted near the level of the stack-top.

Using data collected at Upton, New York, an operational climatology is developed which combines the variables into a single pollution index. Examples are shown of such an index. The limitations of the index result both from the lack of a firm theory and from nonmeteorological factors such as local topography and the nature of the effluent.

1781 The Forecasting of Micrometeorological Variables. Maynard E. Smith. AECU-702, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

The current status of the forecasting program developed for nuclear reactor operations at Brookhaven National Laboratory is discussed in some detail. In the examination of the forecasting method emphasis is placed on the use of relationships between synoptic and micrometeorological variables as they have been determined by observation and climatological studies. The practical application of this type of program to industrial problems, both in the field of atomic energy and otherwise, is considered.

1782 Diffusion of Stack Gases in Stable Atmospheres. Morton L. Barad. AECU-703, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Smoke plumes emitted from elevated sources during inversion conditions and characterized by negligibly small settling rates remain aloft for many miles over fairly flat

PHYSICS

terrain. Photographs of oil-fog plumes taken at the Brookhaven National Laboratory are presented to show the non-isotropic character of diffusion during conditions of strong stability.

Since relatively rapid dilution occurs within the first few meters of a stack, the diffusion problem is treated as a two-phase problem. The first phase may be termed the adrodynamic phase, the second phase, the meteorological phase. The classical diffusion equation is re-examined for possible application in the inversion case. If concentrations of the effluent within the first one or two kilometers of the source are desired, it is desirable to treat the source as an area source of finite concentration rather than a point source of infinite concentration.

1783 Microwave Spectrum of CF_3Br. A. H. Sharbaugh, B. S. Pritchard, and T. C. Madison. Phys. Rev. 77, 302(1950) Jan. 15 (Letter to the editor).

About forty lines, arising from the $J = 4 \rightarrow 5$ and $J = 5 \rightarrow 6$ rotational transitions of CF_3Br^{79} and CF_3Br^{81}, have been measured and analyzed. The nuclear and molecular constants are listed.

1784 A Stark-Effect Microwave Spectrograph. K. B. McAfee, R. H. Hughes, and E. Bright Wilson, Jr. Harvard University, Mallinckrodt Chemical Laboratory, nd. 24p. (NP-1089.)

This paper describes in detail a recent form of Stark effect spectrograph. The basic principle used is the modulation of the absorption of the gas at a low radio frequency by the application of a square wave voltage to an electrode in the wave guide, thus creating a time-dependent, alternating Stark effect. This introduces a modulation of the microwave energy at a low radio frequency in the vicinity of absorption lines. After rectification by a microwave crystal, the signal is amplified and detected by a narrow-band radio receiver or by a tuned radio frequency amplifier followed by a phase-sensitive detector, and applied to the vertical plates of an oscilloscope. The horizontal plates of the oscilloscope are swept by part of the saw-tooth voltage sweeping the reflector grid of the klystron. For the highest sensitivity a pen and ink recorder is used together with an amplifying and detecting system with a very narrow band width, the frequency being swept by a mechanical drive on the klystron. The spectrum observed is considerably more complicated than that given by the simpler spectrograph, but correspondingly more information is displayed. A block diagram for the Stark-effect detection scheme is delineated.

1785 Experimental Arrangement for the Measurement of the Scattering of Slow Neutrons from Weak Sources. C. C. Jonker and J. Blok. Physica 15, 1032-50 (1949) Dec.

To perform scattering experiments with slow neutrons from Ra-Be sources, a sensitive ionization chamber was constructed, filled with natural BF_3; the pressure of the gas was 3 atm; the efficiency for slow neutrons was 50%. A discussion of the properties of this chamber, the amplifier, and the counting circuit is given. It has been possible to adapt the amplifier and the counting circuit so that nearly all pulses caused by slow neutrons are counted. The Fermi-distribution $\cos\theta + \sqrt{3}.\cos^2\theta$ was checked with an accuracy of 1.6%. In view of experiments on single and plural scattering of neutrons the influence of the dimensions of the howitzer on the collimation of the beam of slow neutrons was determined. With this howitzer and a special constructed collimator we obtained a collimation with a mean divergence of 5 deg. (auth)

1786 A High-Efficiency Neutron Detector. J. C. Duckworth, A. W. Merrison, and A. Whittaker. Nature 165, 69(1950) Jan. 14 (Letter to the editor).

The authors investigated the possibility of counting neutrons by detecting the γ rays given off in neutron-induced reactions in B, C, In, and S. The Harwell crystal spectrometer was used to provide a source of monoenergetic neutrons with a comparatively low proportion of accompanying γ rays. The sample was placed in the beam of neutrons diffracted from a calcium fluoride crystal, and the scintillations produced by the resultant γ rays were detected by an RCA 931 photomultiplier tube. In the energy range from 0.04 to 0.2 Mev the efficiency of detection was constant (except for indium), being 1% for boron and 4% for cadmium and samarium.

1787 Neutron Spectroscopy for Chemical Analysis. I. Neutron Properties, Interactions, Velocity Selection. T. I. Taylor and W. W. Havens, Jr. Nucleonics 5, 4-18(1949) Dec.

This article is divided into two parts. The first is devoted to the general properties of neutrons, methods of neutron detection, and to the reactions in which neutrons may be involved, with particular emphasis on the behavior of scattering and absorption cross sections in resonance and nonresonance processes. In the second section, three different types of neutron spectrometers are described. Of these, the mechanical velocity selector and the crystal diffraction spectrometer are fairly old. The third method makes use of a pulsed cyclotron which bombards a target and produces neutrons. The time of flight of these neutrons is measured by means of neutron counters in the path of the neutron beam.

1788 A Solid Detector for the Comparison of Neutron Sources. D. H. Wilkinson. J. Sci. Instruments 27, 16-17(1950) Jan.

A hollow cylinder of manganese is used as a detector of thermal neutrons which are generated by the moderation in a surrounding water tank of fast neutrons from a source placed within the detector. The activation of the detector is investigated as a function of the position within it of a very small neutron source and found to be insensitive to this position. The detector then provides an accurate and sensitive means for the comparison of neutron sources of very different sizes, such as a large radium plus beryllium mixed source and a small radium-beryllium-fluoride neutron standard source. (auth)

1789 Progress Report. M.I.T. Laboratory for Nuclear Science and Engineering, July 1, 1949. 247p. (NP-1272.)

This thirteenth progress report reviews the Laboratory's research progress during the period from July 1, 1948, to July 1, 1949. It deals with research completed and in progress on the following projects: chemistry of Nb; thiocyanate com-

plexes of fission elements; chemistry of Ce; analytical chemistry of Zr; radiometric analysis of fission products; photometric titrations; electrodissolution of metals; ion exchange studies with Hf and Zr; electroseparation of carrier-free tracers; energy of the meson decay electrons; observations with a large square cloud chamber; cosmic ray shower production by penetrating particles; high pressure cloud chamber; ionization bursts under lead in the upper atmosphere; cosmic ray air showers; cloud chamber for synchrotron studies; experiments with an 8 in. cloud chamber; the range of the disintegration electrons of mesons; scintillation counters; 1-Mev Van de Graaff generator; photographic plate techniques; 12 million v positive ion accelerator; positive ion source studies; general electrostatic generator techniques; compressed gas studies; vacuum insulation studies; acceleration tube studies; x-ray and cathode-ray generator studies; phosphors for scintillation counters; solvent extraction studies; ion exchange systems; complexes and complex-formers; radiochemical studies of some activities found in fission material; nuclear isomers; chemical consequences of nuclear transformations; electron transfer between cobaltus and cobaltic amine complexes; structure of ketine dimers; rearrangement of carbonium ions; decarbonylation of polycarbonyl compounds; orientation in aromatic substitution; isotope effects on chemical reactions; C^{14} counting; apparatus and experimental arrangements for studying nuclear cross sections; studies of charged particle groups; masses of Li^{8-7-8} and Be^{9-10}; $C^{12}(p,\gamma)N^{13}$ reaction; photodisintegration of the deuteron; C^{14} research and counting techniques; extrapolation ionization chamber; gamma rays from radioactive processes; the cyclotron and the emergent beam; Ca^{45} toxicity and metabolism experiments; tests and status of the synchrotron magnet; acceleration tube; injection gun; hunt for the beam; quantum electrodynamics; theoretical nuclear physics studies; and cosmic ray research.

1790 Progress Report. M.I.T. Laboratory for Nuclear Science and Engineering, Oct. 1, 1949. 60p. (NP-1273.)

This fourteenth progress report covers the third quarter of 1949 under the following sections. (1) Chemistry of the fission elements group: thiocyanate complexes of fission elements, chemistry of cerium, fundamental polarographic studies; cyanide complexes of cadmium, photometric titrations, ion exchange studies with hafnium and zirconium, electroseparation of carrier-free tracers, instrumentation. (2) Cosmic ray group: observations with large square cloud chamber, shower production by penetrating particles, high pressure cloud chamber, ionization bursts under Pb in the upper atmosphere, air showers, cloud chamber for synchrotron studies, experiments with 8-in. cloud chamber, scintillation counters. (3) Elementary particle scattering group: 1-Mev Van de Graaff generator, photographic plate techniques. (4) 12-Mev generator construction and high voltage research group: 12-Mev positive ion accelerator, positive ion source studies, acceleration tube studies, 2-Mev x-ray generator studies. (5) Nuclear chemistry (inorganic) group: phosphors for scintillation counters, solvent extraction studies, ion exchange equilibria of ions of different charge, complexes and complex formers, radiochemical studies of the fission process, nuclear isomers. (6) Nuclear chemistry (organic) group: rearrangements of carbonium ions, orientation in aromatic

substitution, decarbonylation of polycarbonyl compounds. (7) Nuclear cross sections group: $C^{12}(p,\gamma)N^{13}$ reaction, detection of neutron groups, (8) Radioactivity and cyclotron group: vapor counters, extrapolation ionization chamber, radioactivity, cyclotron and emergent beam. (9) Synchrotron group. (10) Theoretical group.

1791 Progress Report for July, August, and September, 1949. J. R. Dunning. CUD-45, Dec. 1, 1949. 21p.

Neutron Velocity Spectrometer Transmission Measurements: Neutron resonances in the region from 0.003 ev to 10,000 ev were investigated for Re, Ga, Co, Al, Ge, and Mn. Design of the parahydrogen holder for the precise determination of the parahydrogen cross section for neutrons has been completed. Methods of analysis have been considered and thermal conductivity cells ordered. The very low neutron energy intensity has been increased by a factor of 3 using a cold source. A new design is being tested. A low temperature sample holder has been constructed for an experiment to test the paramagnetic scattering of neutrons at low temperatures in MnS. Measurements on various alloys to determine the scattering phase of the neutrons have been completed as have those on fused quartz. Manganese containing occluded hydrogen is also being investigated.

Neutron Scattering: A new scattering chamber has been built, reducing background at the higher energies by a factor of 5 to 10 over the neutron spectrum. The beam of neutrons is found to be about 3 in. × 3 in. in cross section. The gold resonance at 4.8 ev was investigated with high resolution, and the scattering ratio for gold to carbon shows a dip on the low energy side, in agreement with the Breit-Wigner theory. Analysis shows that by using thick targets, the counting rate will be a function only of geometry and σ_s/σ_t. B_2O_3 will be used as a standard target. An experiment to measure the paramagnetic scattering cross section as a function of neutron wavelength, by directly detecting the neutrons scattered in a forward direction, is under way. Twenty-two BF_3 counter tubes have been started, and 4 completed.

Analytical Laboratory and Crystal Growing: The use of resonance absorption peaks in analytical determinations has been tested with a series of standard indium-in-tin samples. Samples used for neutron transmission, and so forth, have been examined for purity.

Radiochemical Laboratories: Sources have been prepared for β-ray spectroscopy and other uses. As^{76} has been separated by a Szilard-Chalmers reaction. A sodium-distillation apparatus has been built.

Instrument Development: A new velocity spectrometer timing circuit is under construction. Revision has been made in the standard pulser, and a new one-tube scale-of-two perfected. Preliminary design work has been done on an n-channel pulse height analyzer, giving 2-v channel widths. Amplifiers and pulse shapers are under construction. Estimates are being made on parts for construction of the new prototype wide band amplifier tube. Various units have been designed, built, and tested for the variable Hg delay line and delayed coincidence circuits. Scintillation counters using RCA 5819 tubes with anthracene crystals have been constructed and tested. Ra γ-rays have been counted with efficiency up to 14%. The effect of increased

crystal thickness has been tested. Two such counters have been set up in a coincidence circuit and tested.

Light Particle Investigation: Pre-set timing and improved regulation have been added to the helical β-ray spectrometer, with which spectra of Pr^{143}, Pm^{147}, and Ca^{45} have been taken. Using a line at 8.7 kev, the effect of the earth's magnetic field and of source charging have been investigated. Various aluminized and other backings have been used to reduce source charging. An experiment has been performed on the angular correlation of the annihilation radiation from Cu^{64} positrons, using scintillation counters in coincidence. The predicted coincidence rate ratio was 2.00, the observed rate was 2.04 ± 0.12, in good agreement. The pressure-ratio across the pumping diaphragm in the apparatus for the neutrino experiment indicates proper differential pumping. A new 12-stage electron multiplier for the detection of recoil ions is under construction. The semicircular focusing β-spectrometer has been recalibrated with annihilation radiation photoelectrons and checked with In^{114} conversion lines, following readjustment of the spinner circuit. The He^6 spectrum has been investigated with 5% resolution and gave a 3.2 Mev end point. The high background in the short-lived β-disintegration experiment has been reduced by coincidence techniques and the use of a counter constructed of polystyrene, which is not activated by neutrons. This is a flow counter (argon-methane). (auth)

1792 Preliminary Results on the Spin of U^{235}. G. L. Stukenbroeker and J. R. McNally, Jr. AECD-2797, Dec. 2, 1949. decl. Jan. 19, 1950. 5p.

Preliminary spectroscopic studies on enhanced U^{235} pointing to a nuclear spin of ½ are reported. (auth.)

1793 Nuclear Quadrupole Moments and Nuclear Shell Structure. C. H. Townes, H. M. Foley, and W. Low. AECU-679, nd. 6p.

A simple model, based on nuclear shell considerations, leads to the proper behavior of known nuclear quadrupole moments, although predictions of the magnitudes of some quadrupole moments are seriously in error: (1) neutrons and protons fit into single particle levels in a scheme similar to those proposed for correlating spins, thus producing what may be called proton and neutron shells; (2) proton and neutron shells tend to be oriented or polarized to allow maximum overlap between proton and neutron distributions. This model leads to the conclusions: (1) for an odd-proton nucleus, the quadrupole moment is primarily dependent on the number of protons; (2) for an odd-neutron nucleus, the magnitude of the quadrupole moment depends on the number of protons, but its sign is determined by the number of neutrons; (3) for odd-odd nuclei, estimation of quadrupole moments is more complex and depends on the way in which the mechanical moments of the odd neutron and odd proton add; if these moments are essentially parallel, the quadrupole moment should be of the same sign and approximately the same magnitude as for a similar odd-proton nucleus; if the neutron and proton mechanical moments are not essentially parallel, the quadrupole moment magnitude should be considerably reduced.

1794 The Effect of Electronic Paramagnetism on Nuclear Magnetic Resonance Frequencies in Metals. W. D. Knight. AECU-685, nd. 1p.

The document is in abstract form; it is reproduced below in its entirety.

Experiments have been performed (W.D. Knight, Phys. Rev., Oct. 15, 1949) which show conclusively that nuclear magnetic resonance absorption in many metals occurs at frequencies which are appreciably higher than might be expected from the known nuclear g-values and the applied magnet fields. This deviation in resonance frequency varies from 0.036% of the expected value in Li^7 to 1.20% in Pb^{207} Measurements on Be^9, accurate to about ±0.002%, fail to disclose the existence of such a frequency shift. Assuming g(I) to be invariant for a given isotope, one can describe the effect in terms of a paramagnetic contribution to the total magnetic field at the nucleus. To be sure, the volume susceptibility of most metals is too small (in many cases negative) to account for the effect. However, the average magnetic field at the nucleus will be greater than the average field in the volume of the metal if the conduction electrons, in addition to being paramagnetic, exist in states which allow them to spend appreciable time near the nucleus. The shift should be of the same order, then, as the hyperfine structure splittings of the corresponding atomic states. Quantitative agreement with experiment is obtained for Li^7 and Na^{23}. For Be^9, the absence of a measurable shift is justified.

1795 Nuclear Magnetic Resonance Shift in Metals. W. D. Knight. AECU-698, nd. 5p.

The purpose of this letter is to report the observation of a shift in the nuclear magnetic resonance frequencies from expected values in five metals, Li, Na, Al, Cu, and Ga, in magnetic fields ranging from 5 to 10 thousand gauss, using an automatic search type radiofrequency spectrometer (R. V. Pound, Phys. Rev., 72, 527(1947)). The magnitudes of the signals observed were in all cases at least 20 times noise amplitude, and in all cases the resonance frequencies, for constant magnetic field, were higher by tenths of a per cent than the resonance frequencies observed in salts of the corresponding metals. The absolute accuracy of the frequency measurements was about 0.01% while small frequency differences were accurate to about 0.002% of the average frequency.

1796 The Low States of Li^7. R. Avery and C. H. Blanchard. University of Wisconsin. M-4459, Nov. 1949. 22p.

An attempt is made to account for the positive quadrupole moment of Li^7 as well as other known ground state data (spin; magnetic moment, $Be^7 \xrightarrow{K} Li^7$, Li^{7*} lifetime and branching ratio), on the assumption that the wave function belongs to an s^4p^3 configuration of nucleons. This is found to be possible with only one particular form for the spin and angular dependence of the function. This form is very different from that predicted by previous theory, in particular the D and P state probabilities are found to be 80% and 20%, respectively. It should be emphasized that the validity of the analysis depends on the accuracy of the assumption that the quadrupole moment is due only to the charge distribution of the nucleons, with no contribution arising from their interaction. An investigation is also made of the spin of the Li^7 480 kev excited state. Previous arguments for a high spin are reviewed. Assuming the s^4p^3 configuration for the excited state, further analysis shows that spin ½ is consistent with experimental

data (Be^7 K capture data; $Li^{7*} \rightarrow Li^7 + \gamma$ lifetime). Consistency cannot, however, be obtained with spin $\frac{3}{2}$ or $\frac{1}{2}$. For spin $\frac{3}{2}$, the margin of disagreement is small; for spin $\frac{1}{2}$ it is appreciable. On the assumptions made, no agreement is possible for spin greater than $\frac{5}{2}$. 15 references. (auth.)

1797 Elementary Particles and the Structure of the Nucleus. G. Allard. Nature. La, 26-7(1950) Jan. (in French).

The author describes the early theory that the nucleus is composed of protons and electrons, and the difficulties which this theory entails. He then discusses the proton-neutron theory of nuclear structure and shows how these difficulties are overcome. The question of electron and positron emission is then treated in the light of the proton-neutron theory, and the Fermi and Yukawa theories of nuclear forces are discussed after a short section on the nature of elementary particles. In conclusion the author notes the possibility that the number of elementary particles may eventually be reduced if it can be shown that some of the particles are excited states of others.

1798 Half-Life of Slow Positrons. I. Pomeranchuk. Zhur. Eksptl. i Teoret. Fiz. 19, 183-4(1949)(Letter to the editor, in Russian).

As a rule, positrons slow down to very small energies (a few ev) before they undergo annihilation with an electron belonging to an atom. Owing to the repulsive forces of the nucleus, the low-energy positron cannot penetrate far into the atom's interior and is thus able to annihilate with one of the outer electrons only. The effect must be a small (less than 1 deg.) deviation of the angle between the annihilation quanta from 180 deg. This is in agreement with the findings of Vlasov and Tsirelson (Doklady Akad. Nauk. S. S. S. R. 59, 879(1948)). The foregoing discussion shows that the formula $\tau = 1/NZ\sigma v$ for the half-life of the positron is not correct, inasmuch as it does not take into consideration the nuclear repulsion (N is the number of nuclei in 1 cm^3, σ is the annihilation cross section, v is the positron's velocity).

1799 Nuclear Dipole Vibrations and the Surface Symmetry Energy. R. D. Present. Phys. Rev. 77, 355-6(1950) Feb. 1.

The frequency of nuclear electric dipole vibrations of the type suggested by Goldhaber and Teller (Phys. Rev. 74, 1046 (1948)) is derived on the basis of the semi-empirical nuclear model. The resulting formula, taken together with the (γ,n) and (γ,f) cross section data of Baldwin and Kleiber (Phys. Rev. 71, 3(1947); 73, 1156(1948)), determines a lower bound for the term in the surface energy depending on $N-Z$ (surface symmetry energy). This is close to an upper bound estimated by Feenberg (Revs. Modern Phys. 19, 239(1947)), and one may tentatively assume that the nuclear surface tension contains a factor $1-0.4(N-Z)^2A^{-2}$. (auth.)

1800 Nuclear Induction Due to Free Larmor Precession. E. L. Hahn. Phys. Rev. 77, 297-8(1950) Jan. 15 (Letter to the editor).

In the study of transient and steady state phenomena concerning nuclear magnetic resonance it is well known that the nuclear magnetic moment possesses a flipped spin state having a phase memory of the order of T_2, the total relaxation time, which ranges from $\sim 10^{-3}$ to a few seconds in various substances. On the basis of this property Bloch (Phys. Rev. 70, 460(1946)) has pointed out that one can expect to obtain a nuclear induction signal in the absence of an applied r-f field after having suddenly perturbed the spin ensemble by the application of an r-f field pulse of short duration and of resonant frequency. An experiment was carried out to detect such an effect. Following the r-f pulse, an exponential nuclear induction signal appeared whose decay time depended on the nature of the sample, the nature of the field, and the intrinsic decay time of the spin ensemble due to lattice conditions. The form of this decay curve is calculated from Bloch's equations, and the experimental results are in good agreement with the theory.

1801 Numerical Value of the Lamb Shift. H. A. Bethe, L. M. Brown, and J. R. Stehn. Phys. Rev. 77, 370-4(1950) Feb. 1.

The average excitation potential of the 2s state of hydrogen which occurs in the Lamb shift, is calculated numerically and found to be 16.646 ± 0.007 Ry. This gives a theoretical value of 1051.41 ± 0.15 Mc for the Lamb shift, compared with the latest experimental value of 1062 ± 5. It is not known whether the discrepancy of 10 Mc can be explained by relativistic effects. Simple analytical approximations are discussed which make plausible the high value of the average excitation potential and give a good approximate value for it. (auth.)

1802 On the Effects of Internal Nuclear Motion on the Hyperfine Structure of Deuterium. Francis Low. Phys. Rev. 77, 361-70(1950) Feb. 1.

The effects of internal nuclear motion on the hyperfine structure of deuterium are investigated, using Dirac theory for the electron and nonrelativistic theory for the nucleus. Although the final result is in fair agreement with experiment, theoretical and experimental uncertainties are at present too large to allow any conclusions to be drawn concerning the possible deviation of nucleon magnetic fields from those of simple dipoles. (auth.)

1803 Trilinear Chart of Nuclear Species. William H. Sullivan, New York, 1949, John Wiley and Sons, Inc. 9p.

This chart presents the systematics of, and physical constants data for all experimentally identified nuclear species (nuclides) from information available up to approximately June 1949.

1804 Upper Limit of Spin-Spin Interaction Factor. G. J. Bene, P. M. Denis, and C. R. Extermann. Phys. Rev. 77, 288(1950) Jan. 15 (Letter to the editor).

The nuclear induction method was applied to determine the gyromagnetic ratio of protons in water, first in an iron-cored electro-magnet, then in air-cored Helmholtz coils. It was not possible to detect any difference between the two resonance fields. This result makes it possible to set an upper limit for the spin-spin interaction factor introduced by Stueckelberg (Phys. Rev. 73, 808(1948)). It is possible to attain a higher accuracy by determining the ratio of the nuclear moments of fluorine and hydrogen successively in the two different types of fields. This was done and the same

ratio was found to three significant figures, confirming the previous negative result.

1805 Natural Convection Cooling of Liquid Homogeneous Reactors. Howard Schwartz. AECU-706 (NAA-SR-40), Dec. 20, 1949. 24p.

This paper presents a graphical method for the design of natural convection cooling systems for liquid homogeneous reactors of the "Water Boiler" type. A convenient method of relating the variables involved is developed and a plot made from which, for given geometry, size of core, and temperature limitations, the maximum heat dissipation rate by natural convection is determined. As an illustration, a specific application of this plot is considered. (auth.)

1806 On the Reaction $Mg^{24}(p,\gamma)Al^{25}$. T. Grotdal, O. M. Lönsjö, R. Tangen, and I. Bergström. Phys. Rev. 77, 296-7(1950) Jan. 15 (Letter to the editor).

Targets composed of the separated isotopes of Mg were prepared in the isotope separator of the Nobel Institute at Stockholm and exposed to protons from the 500 kv Van de Graaff machine of the University of Oslo. The targets were bombarded for 20 sec and the resulting positron activity was measured with a thin-walled G-M tube. Because of the limited proton current available, only the strong resonances at 222 and 417 kv could be investigated. Positron activity corresponding to these resonances was found only in the Mg^{24} target, showing that the reaction $Mg^{24}(p,\gamma)Al^{25}$ takes place.

1807 Erratum: Short Range Alpha Particles from Fluorine and Lithium Bombarded by Protons. W. E. Burcham and Joan M. Freeman. Phys. Rev. 77, 287(1950) Jan. 15 (Letter to the editor). (See also NSA 3-794.)

An error was made (Phys. Rev. 75, 1756(1949)) in the calculation of the energy of the excited state of Be^8 from observation of the short range α particles in the $Li^7(p\gamma)Be^8$ reaction. The emission of α particles of energy 1.38 ± 0.08 Mev at 104° with the incident proton beam of energy 0.44 Mev requires an energy release in the break-up of Be^8 of 3.0 ± 0.2 Mev. The energy of the excited state is 2.9 ± 0.2 Mev instead of 2.6 ± 0.2 Mev as previously given.

1808 The Oscillator for the Injector Cyclotron of the Quarter-Scale Bevatron. W. R. Baker. UCRL-457, Sept. 20, 1949. 10p.

A detailed description is given for an oscillator designed to provide a peak pulse power of 100 kw at 100 kv to the dees of the 20-in. injector cyclotron of the quarter-scale bevatron.

1809 Design of an Equipotential Tray. G. E. Mellen, E. C. Witt, A. L. Boch, and R. S. Livingston. Y-530, July 29, 1948. 15p.

In the development of particle accelerators, an equipotential tray would be useful for experimentally determining the potential distributions in regions which are too complex to be analyzed mathematically. Study of such distributions would be valuable aid in determining new geometries and gaining empirical knowledge. The general objectives in designing an equipotential tray are to provide an apparatus which will accurately locate points on any equipotential line

of the system being studied and to provide a convenient means for transferring such points to a scale drawing of the system. Design problems are discussed and the design details and performance are given for an apparatus which has been constructed and tested. The location of points on equipotential lines by this apparatus is valid and reliable for electrostatic systems. Fields plotted by use of the tray do not include the effect of space charge on the equipotential lines, therefore, the tray may not give a true picture of conditions in a region traversed by a beam of ions.

1810 Betatron. Bibliography. L. G. Dobbie. Australia, Aug. 1948. 4p. (NP-1229.)

Forty-two references covering the period 1930-48 have been compiled from Science Abstracts, Sections A and B.

1811 Betatron Injection into Synchrotrons. F. K. Goward. Atomic Energy Research Establishment Report No. AERE-G/R-191, Apr. 23, 1948. 33p.

The paper states the factors influencing the proportion of electrons which may be trapped and accelerated in a transition from betatron to synchrotron operation; this transition is a vital factor influencing the design of the normal electron synchrotron. Machines of various energies are studied, and it is shown that the important considerations in the design are quite different in different energy ranges. The theoretical predictions are compared with experimental evidence obtained on 14 and 70-Mev synchrotrons, and the agreement is sufficient to give confidence in the theory. A tentative deduction is made from the experimental results, that the spread of energies of the electrons which are injected into a betatron is approximately that corresponding to the donut cross-section. (auth.)

1812 Cyclotron; Continuous Wave Fixed Frequency Excitation. Bibliography. L. G. Dobbie. Australia, Aug. 1948. 6p. (NP-1230.)

Sixty-nine references covering the period 1930-48 have been compiled from Science Abstracts, Sections A and B, and from a few other sources.

1813 Experiments on Electron Capture and Phase Stability in a 14-Mev. Synchrotron. T. R. Kaiser and J. L. Tuck. Proc. Phys. Soc. (London) 63 A, Pt. 1, 67-74(1950) Jan. 1.

Experiments were made by interrupting the radiofrequency accelerating voltage for intervals during the acceleration in a synchrotron, and observing the effects on the output. The process of capture is found to be more efficient than would be expected for an instantaneously developed radiofrequency accelerating voltage. The synchrotron acceleration may be interrupted for a short period without losing more particles than would be accounted for by contraction of the beam radios during the interruption, so that for sufficiently short periods of interruption the loss is negligible. This demonstrates that the phase at which electrons enter the resonator during capture is of no consequence under the conditions prevailing. The results are in quantitative agreement with a theory put forward by Kaiser (Proc. Phys. Soc. (London) 63 A, 52(1950)) which takes into account the finite rate of rise of resonator voltage, and with the general theory of synchrotron stability. (auth.)

PHYSICS

1814 The Harwell Cyclotron. T. G. Pickavance, J. B. Adams, and M. Snowden. Nature 165 90-1(1950) Jan. 21.

The Harwell cyclotron is of the frequency modulated type, producing protons of about 180 Mev. The principle of this type of operation is briefly outlined. The magnet, dees, vacuum system, and electrodes are described and performance characteristics are given. At first the running time will be devoted largely to the development of the instrument itself, but the projected work includes experiments on the attenuation of neutron beams in different elements, and the production of mesons.

1815 On the Capture of Particles into Synchrotron Orbits. T. R. Kaiser. Proc. Phys. Soc. (London) 63 A, Pt. 1, 52-66(1950) Jan. 1.

A theory is developed for the capture of particles into synchrotron orbits when the radiofrequency accelerating voltage rises from zero to its maximum value in a finite time. It is shown that if this time of rise is sufficiently long, all particles originally occupying a band of width $1/\sqrt{2}$ times the maximum width of the final stable region for synchrotron phase oscillations will be captured, irrespective of the initial phase at which they enter the accelerating gap. This conclusion would seem to be in agreement with the observed characteristics of existing electron synchrotrons. (auth.)

1816 The University of Chicago 170-Inch Synchrocyclotron; Progress Report II; July 1948 - July 1949. Herbert L. Anderson and John Marshall. University of Chicago Institute of Nuclear Studies, nd. 102p. (NP-1231.)

Progress in the construction of the 170 in. synchrocyclotron during the second year is recorded. The estimated operation date is May 1, 1950.

1817 Analytical Method for Determining Transmission and Absorption of Time-Dependent Radiation through Thick Absorbers. II. Source Intensity, Time-Dependent. G. Allen. Cleveland, U. S. Lewis Flight Propulsion Laboratory, Sept. 1949. 11p. (See also NSA 3-2007.)

Matrix methods are employed in solution of absorption problems in which incident radiation is known arbitrary function of time. The case of plane source of polychromatic radiation of several types at normal incidence to plane absorber is considered.

1818 Electromagnetic Radiation Due to Proton-Neutron Collisions. V. Ya. Faĭnberg and E. L. Feĭnberg. Doklady Akad. Nauk. S. S. S. R. 68, 45-7(1949)(in Russian).

Experiments with fast protons and neutrons ($E \sim 10^8$ ev) (Hadley et al, Phys. Rev. 75, 351(1949)) showed the important part exchange forces must play in the interaction neutron-proton. Pomeranchuk and Shmushkevich (Doklady Akad. Nauk S. S. S. R. 64, 499(1949)) pointed out that a specific electromagnetic radiation, corresponding to the considerable change in electric dipole moment of the system, must result from the exchange of charges. The present authors show that this specific radiation is not the only possible outcome of the

PHYSICS

interaction. In general, a charge exchange between a proton and a neutron may modify not only the electric moment of the system, but its magnetic moment as well. Since the orientation of a proton's magnetic moment coincides with the spin, and that of a neutron is opposed to it, it will depend on the initial mutual orientation of the two spins whether a change in the orientation of the system's magnetic moment will result or not; in the former case, a supplementary radiation must take place. It is shown that this radiation consists predominantly of high frequency quanta and is isotropic. It is seen that the analysis of the emitted quanta can furnish information on the character of the nuclear forces present, viz. whether they are forces of the usual type (Wigner), or forces involving charge exchanges only (Heisenberg), or charge and spin exchanges (Majorana), or spin exchanges alone (Bartlett).

1819 Electron Scattering in Thin Layers. L. M. Biberman, E. N. Vtorov, I. A. Kovner, N. G. Sushkin, and B. M. Yavorskiĭ. Doklady Akad. Nauk. S. S. S. R. 69, 519-20(1949)(in Russian).

The numerous experimental works on the angular distribution of electrons scattered by gases or by thin layers of solids deal with angles exceeding 1 deg. The method described here, based on the use of a modified electron microscope, permits measurements in the interval from 3×10^{-4} to 3×10^{-2} radian. As an example, the angular distribution of electrons scattered by a Cr layer 4.9×10^{-6} g/cm^2 is given, for 80, 60, and 30 kv. The results are compared with a theoretical curve for the elastic scattering, calculated with the aid of the Thomas-Fermi model. The comparison shows a drastic discrepancy at small angles ($\sim 3 \times 10^{-3}$ radian), viz., a large excess of measured numbers of scattered electrons over the theoretical. This may point to inelastic effects; however, a closer investigation is impossible, owing to the absence of theoretical expressions for inelastic scatterings at small angles.

1820 Inelastic Scattering of Protons by Aluminum and Carbon. C. Levinthal, E. A. Martinelli, and A. Silverman. UCRL-458, Nov. 16, 1949. 14p.

The energy spectra of protons emitted from carbon and aluminum when bombarded by protons of 32 and 16 Mev from the Berkeley linear accelerator have been investigated by means of photographic plates. The data obtained are discussed and interpreted.

1821 Straggling of Electrons near the Critical Energy. II. L. Eyges. Phys. Rev. 77, 81-5(1950) Jan. 1. (See also NSA 3-1222.)

The straggling of electrons with energy near the critical energy is discussed, using an approximation to the expression for the radiative cross section which takes into account its variation with energy. From the results the "track length" of electrons (neglecting pair production and Compton effect) is evaluated for some special cases and compared with the numerical calculations of Richards and Nordheim (Phys. Rev. 74, 1113(1948)). The agreement appears to be good. (auth.)

1822 Atomic Nuclear Models and Beta Decay. Swami Jnanananda. J. Sci. Ind. Research 8, 397-413(1949) Oct.

PHYSICS

This article presents a general survey of the historical development and the present state of the theory of β decay. The author outlines the difficulties implicit in the proton-electron theory of nuclear structure and shows how these difficulties are avoided in the proton-neutron theory. An elementary quantum mechanical derivation of the Fermi theory of β decay is given, and the distinction between forbidden and allowed transitions is noted. Sargent diagrams are reproduced, and their relation to the Fermi theory is explained. It is demonstrated that the electron neutrino interaction cannot account for nuclear forces and the meson theory is briefly outlined. The author concludes with a section of K-capture and positron emission.

1823 A Delayed Coincidence Counting Measurement of $Hg^{203,205}$. Daniel Binder. Phys. Rev. 77, 291(1950) Jan. 15 (Letter to the editor).

An attempt has been made to measure the half-life of the γ ray in the β-γ-cascade emission from $Hg^{203,205}$ by a delayed coincidence measurement. The experimental arrangement makes use of a proportional counter as the β-ray detector and a 931A photomultiplier tube with an anthracene crystal as the γ detector. The $Hg^{203,205}$ source was placed between the two counters with an absorber to stop the β rays from entering the scintillation counter. The counting rate was then measured for various delay times, positive and negative, and the plot of counting rate against delay time is seen to be symmetrical about the delay time zero. Consequently, it may be shown that the γ-ray half-life is less than 2×10^{-9} sec. The author concludes that Δl is not greater than 2 for this transition, in agreement with the value calculated by Saxon (Phys. Rev. 74, 849(1948)) from the ratio of K and L conversion coefficients.

1824 Determination of the Decay Constant of the K-Capture in K^{40}. E. K. Gerling, N. E. Titov, and G. M. Ermolin. Doklady Akad. Nauk S. S. S. R. 68, 553-6 (1949)(in Russian). (See also NSA 3-894.)

From the K^{40} and radioactive A^{40} contents in a sylvite of known geologic age, the authors (Izvestiya Akad. Nauk. Otd. Khim. Nauk, No. 2 (1949)) determined the decay constant of the transformation of K^{40} into A^{40} by K-capture; the value found was 30 times smaller than the constant 1.9×10^{-9} $year^{-1}$ determined by Bleuler and Gabriel (Helv. Phys. Acta 20, 67(1947)) from a study of x-rays emitted by K salts. In a new series of analyses the present authors used, besides the same sylvite (age 200×10^6 years), a carnallite of the same deposit, two nephelines (350×10^6 and 280×10^6 years), and a very old microcline ($1,700 \times 10^6$ years). In order to free the A atoms from the crystal lattices, the minerals were either dissolved or melted. By taking into account the small quantities of A^{36} freed along with A^{40}, the mean value for the K-decay constant of K^{40} was found to be $(6.1 \pm 1.2) \times 10^{-11}$ $year^{-1}$. This should be the constant sought if no appreciable leakage of A from the minerals took place during the geologic time. A discussion of this question, which is that on the heat of diffusion of A atoms through crystal lattices, involves considerations on the known values of the heat of diffusion of He, on the relative size of A and He atoms, and on the temperature of melting used in the present work. As a result, the leakage in question must have seldom exceeded 20%.

PHYSICS

1825 Determination of the Maximum Energy of Beta-Rays from Cu-62 by a New Method of Analyzing Absorption Data. L. Katz, A. S. Penfold, H. J. Moody, R. N. H. Haslam, and H. E. Johns. Phys. Rev. 77, 289-90 (1950) Jan. 15 (Letter to the editor).

Absorption measurements were made with a view to resolving the discrepancies in the previously published values for the end point of the β spectrum for Cu^{62}. Determination of the end point by visual inspection of the absorption curve appeared to be very inaccurate. Instead, the authors assumed that the lower part of the absorption curve, that part that represented the absorption of the high energy betas, followed an approximate power law. It was then possible to determine the upper limit by a method of successive approximations. These measurements gave an end point value of 2.92 ± 0.06 Mev, in agreement with a value reported by Becker and Kirn (Phys. Rev. 76, 182(1949)).

1826 Experimental Beta-Gamma-Angular Correlation. Richard L. Garwin. Phys. Rev. 76, 1876(1949) Dec. 15 (Letter to the editor).

The number of γ rays emitted by a nucleus into unit solid angle has been measured as a function of angle with the preceding coincident β ray. Scintillation counters were used as detectors, the β counter being fixed with respect to the source and placed in an evacuated tank to avoid scattering. Measurements were taken at 20 positions, giving 10 points on the correlation curve between 45 and 180 deg. No anisotropic correlation was observed for any of the sources used. This result is in conflict with the theory of β decay (Falkoff, Ph. D. Thesis, University of Michigan (1948); Yang, Phys. Rev. 74, 764(1948)), as it applies to the forbidden transitions which were studied in these experiments. Further experiments are under way on more test cases of the theory; these are forbidden β transitions followed by a single γ emission to an even-even ground state.

1827 Investigation on the Angular Correlation of Internal-Conversion Electrons. L. I. Rusinov and E. I. Chulkin. Doklady Akad. Nauk S. S. S. R. 68, 1029-32 (1949)(in Russian).

The theory of the angular correlation of internal-conversion electrons at two consecutive nuclear transitions has been given by Berestetskiĭ (Zhur. Eksptl. i Teoret. Fiz. 18, 1070(1948)). The knowledge of this correlation permits a determination of the multipole character of nuclear radiations and of the angular momenta of isomers. The authors measured the angular correlation of the conversion electrons of Br^{80*}, emitted at transitions from this latter level (excitation energy 85 kev), and from the level $Br^{80'}$ (37 kev), to the ground state. Three counters, A, B, C, each with a window at one end, were placed in one plane around a center O, their axes forming angles AOB = BOC = 75 deg., and the radioactive Br preparation occupying the center O. The numbers of coincidences N_{AC} and N_{BC}, and the numbers of the internal-conversion electrons M_A and M_B, gave the ratio $K = \frac{N_{AC}}{M_A} : \frac{N_{BC}}{M_B}$ which, if there is a correlation, must be >1. It was found (average) $K = 1.63 \pm 0.24$. Consequences: the mechanical momentum of $Br^{80'}$ is not zero; its half-life is less than 10^{-12} sec; the radiation emitted during the transition from this level is an electric dipole

radiation; the angular momentum of Br^{80*} could be determined by comparing the results obtained here with those calculated from the possible values of mechanical momenta of Br in its various states.

1828 Nuclear Impulse in Electron Pair Creation. G. E. Modesitt and H. W. Koch. Phys. Rev. 77, 175-9 (1950) Jan. 15.

The nuclear impulses were studied for electron pairs produced in an air-filled cloud chamber by the continuous spectrum of x-rays from a 22-Mev betatron. Less than one-third of the momentum transfers to the nucleus were found to consist of values less than mc. The probability $\Phi(P_n)$ of a momentum transfer P_n was found to decrease rapidly with decreasing P_n for $P_n < mc$. (auth.)

1829 Radioactive Xenon 125, and Xenon 127. D. L. Anderson and M. L. Pool. Phys. Rev. 77, 142 (1950) Jan. 1 (Letter to the editor).

Cyclotron bombardments by α particles on two samples of tellurium have been made. In one sample the Te^{122} isotope had been enriched to 79.4%, and in the other sample the Te^{124} isotope had been enriched to 83.9%. A previously unreported 20 ± 1-hr activity appeared in the Te^{122} sample. By means of a chemical separation this 20-hr activity was shown to be due to a gas, presumably xenon. The reaction leading to the 20-hr activity is probably $Te^{122}(\alpha,n)Xe^{125}$. It was established that the Xe decays largely by K capture. Other authors have previously reported a 34-day half-life acitvity obtained by a proton bombardment of iodine (Creutz et al, Phys. Rev. 58, 481(1940)). This activity was tentatively assigned to Xe^{127}. The same activity may be obtained by bombarding enriched Te^{124} with α particles, probably through the reaction $Te^{124}(\alpha,n)Xe^{127}$. This result adds weight to the previous tentative assignment.

1830 Units of Radioactivity. L. F. Curtiss, R. D. Evans, Warren Johnson, and Glenn T. Seaborg. Phys. Rev. 77, 142(1950) Jan. 1 (Letter to the editor).

In November 1947 a joint committee of the Divisions of Chemistry and Chemical Technology and of Mathematical and Physical Sciences of the National Research Council was appointed to make recommendations regarding standards and units of radioactivity. This committee suggested that the curie be defined as a quantity of material undergoing 3.7×10^{10} disintegrations/sec, the rutherford as a quantity of material undergoing 10^6 disintegrations/sec, and that the roentgen rate/hr at one meter be adopted for the quantitative comparison of γ-ray sources.

1831 Further Investigations on Proton Isobars in the Theory of Radiation Damping. Ning Hu. Proc. Roy. Irish Acad. 52 A, 223-52(1949) Aug.

It was pointed out by Kramers and Heisenberg (Z. Physik 120, 513, 673(1943)) that, if the S-matrix is an analytic function of the momentum variables, the energy values of the closed states and the energy levels and decay constants of the radioactive states can be obtained by continuing the S-matrix analytically to complex values of the momentum variables. This method is extended to give the cross section for photodisintegration and the magnetic moment of the closed states derived from a given S-matrix. As an example, the general theory is applied to the nucleon isobar states found in (W. Heitler and N. Hu, Proc. Roy. Irish Acad. 51 A, 9(1947)).

1832 On the Charged Meson Pair Theory of Nuclear Forces. Parts I and II. Olof Brulin. Arkiv Fysik 1, 117-90(1949) Nos. 4 and 5.

The purpose of this paper is to give a more complete discussion of the charged scalar and vector meson pair theories of the nuclear forces. It is, however, limited to a treatment of the problem in the perturbation approximation. Hjalmars (Arkiv Fysik 1, 3(1949)) has deduced the expression for the contribution to the Hamiltonian, corresponding to the possible interaction terms between a pair of scalar or vector mesons and a nucleon, fulfilling the requirements of Lorentz-invariance and charge-independence. In the present paper the corresponding nuclear interaction potential is calculated in the perturbation of the second order, neglecting the recoil and assuming the nucleons to be fixed during the transmission of the field. Even the terms depending on the velocity of the nucleons are calculated in order to get an estimate of the errors which arise when these terms are neglected. The calculation is analogous to that used by Klein (Arkiv Mat. Astron. Fysik 30A, 3(1943)). The question of convergence is treated in some particular cases, assuming that the nucleons have a finite extension. Further some criteria for the validity of the perturbation calculation are deduced. A quantitative analysis of the proton-proton scattering is made assuming a particular choice of pair interaction and of meson mass. The analysis would, however, be about the same with a different choice of mass and interaction term. The problem of the deuteron and of the neutron-proton scattering is only qualitatively discussed. As distinguished from the former case, forces arising from the linear charged meson theories, may play an important role here in addition to the pair forces, and thus, these cases are not so decisive for the possibilities of the pair theories. (auth.)

1833 On the Theory of Birkhoff. Marcel Kadosch. Rev. sci. 86, 707-10(1948) Dec. (in French).

The theory of Birkhoff (Rev. sci. 86, 115(1948)) represents an attempt to affect a synthesis of gravitational theory and electromagnetic theory within the framework of special relativity, abandoning the geometric interpretation of the gravitational field. The article consists of two parts; the first part is a study of the static gravitational field using the equations of Birkhoff. The general equations so derived are then applied to the case of a central attractive body. The author then discusses gravitational fields in general, comparing the Birkhoff theory with the general relativistic theory, and with the classical theory of Newton.

1834 The Self-Stress of the Electron. F. Rohrlich. Phys. Rev. 77, 357-60(1950) Feb. 1.

The diagonal elements of the symmetrical energy-momentum tensor density of an electron at rest are calculated. The covariant formalism of Tomonaga, Schwinger, Feynman, and Dyson is used, and it is shown that it is necessary to use a relativistic cut-off in addition to the covariant separation of the infinite renormalizations. Therefore, "formalistic regulators" are used in the form of additional neu-

PHYSICS

tral vector fields. The integrations are carried out with the Feynman method (Phys. Rev. 76, 749, 769(1949)). The resultant vanishing value for the self-stress constitutes a proof of the consistency of the relativistic formalism. It is shown how

PHYSICS

the Feynman-Dyson method (Feynman, op. cit.; Dyson, Phys. Rev. 75, 486, 1736(1949)) can be used for the calculation of expectation values of operators, of which the self-stress calculation constitutes an example. (auth.)